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OBSERVATIONS ON GAS-BACILLUS INFECTION IN FRANCE

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THE following observations were gained from a personal experience of more than a year's work among the French wounded, combined with opportunities for noting the ideas and methods of French surgeons. Of all the classes of wounded seen in the present European war, the most terrible and formidable are those of the so-called gas-bacillus infection. This infection well known in former wars and but little known in times of peace, has played an important part in the mortality of the present warfare. The protean aspects of gas-bacillus infection may be noted by the fact that in medical literature it is designated by at least thirteen different names according as the authors have been impressed by different symptoms and by the rapidity and gravity of their evolution. The term "gas-bacillus infection" is used in this article, as it is the expression commonly employed by American surgeons in France, the term "gas gangrene" being manifestly unsuitable. The French employ the designation *l'infection gazeuse* or *l'infection gazogène*. A translation of the latter term as "gas-producing infection" may be accepted as more expressive than the term gas-bacillus infection in general use.

Out of the maze of complicating ideas as to etiology, symptomatology, clinical divisions, and methods of treatment have evolved definite conclusions which are of permanent value and which should prove their value in case our soldiers should become involved in the grim realities of war.

Statistics as to the number of cases treated and the mortality are not available, as the official records have not been made public. Records of individual surgeons or hospitals vary considerably, depending on different factors, such as the location of the hospital, the character of the wounds received and the period of time that has elapsed between the receipt of the wound and admission to the hospital.

ETIOLOGY

The following factors will be considered:

1. Soil.
2. Weather.
3. Clothing.
4. Skin.
5. Projectile.
6. Character of wound.
7. Flora of wound.

1. The soil of France has been cultivated and fertilized for centuries, and germs of many kinds and particularly spores are to be found in great quantities. The conditions are very different from what existed say in South Africa in the Boer War where to a large extent the battle grounds were uninhabited country. In the Boer War few surgeons saw gas gangrene. In this war few or none have escaped seeing it. The infection is considered by some to be more prone to develop in certain zones than others. Thus the wounded

from the cultivated Champagne region show perhaps a higher percentage of gas-bacillus infection than wounded from the mountainous Vosges. Such important other factors as the season and the congestion of wounded enter into consideration so that in the absence of further data, the influence of the soil of a particular region should not be given too much prominence. The present method of trench warfare contrasts markedly with that of former wars. Extensive movement of troops and open fighting when troops marched out as on a parade is no more and the soldier now lives in constant intimacy with the soil. Life in the trenches is not conducive to cleanliness, and the earth which protects the soldier soils his clothing and penetrates every pore of his skin. The large number of men living in such a restrained area for months adds to the contamination of the soil already existing. The construction of the trenches necessitates corners and recesses where the sun does not penetrate and where the growth of bacteria is favored. In spite of precautions fæcal matter is transplanted by the feet and contaminates the bottom of the trenches.

2. There are said to be about 250 rainy days in the year in northern France. The rain brings about a condition of mud almost inconceivable. The narrow, deep trench is not favorable to evaporation and the great numbers of men crowded together add to the process of mud making. Bad weather not only causes mud but wets the soldier's muddy uniform so that the dirt is diffused through the cloth. In warm weather dust is very persistent, permeates the clothing, and combined with perspiration creates a favorable condition for germ development.

3. The French uniform is made of a heavy kind of felt. The soldier wears his overcoat almost always even on the hottest days. The clothing moist from rain or perspiration, and more or less dirty, offers an excellent habitat for bacteria and probably the majority of gas infections originate from the piece of cloth that is carried into the wound. Fleming in an examination of soldiers' uniforms reports having found bacillus perfringens in 83 per cent, bacillus tetanus in 33 per cent, streptococci in 41 per cent, and staphylococci in 17 per cent.

4. The period of time for a soldier to be on duty in the first line varies in different regions and at different times. In times of relative calm, provision can be made for the soldiers bodily cleanliness. In times of stress, no such provision can be taken advantage of and it is not uncommon for a wounded man on admission to the hospital to have his clothes removed for the first time in two or three weeks. Owing to the lack of opportunities for cleanliness there is usually fæcal contamination of the buttocks and thighs. The duration of time on the battle field should be mentioned. While in favorable circumstances the majority of the wounded are able to have their first-aid dressing applied at once, yet it is not uncommon for a wounded man to lie on the field for hours before receiving attention.

5. The projectiles, pieces of shells, bombs, grenades, and shrapnel cause gas infection particularly because of pieces of clothing, dirt, bits of stone, pebbles, and even straw and pieces of wood which are carried into the wound. The rifle ball fired from a distance and entering the tissues by its point creates usually an aseptic wound. The rifle ball deflected or fired at close range creates a wound liable to infection. The pieces of shell are the worst offenders in that they carry in pieces of clothing into the depths of the wound, their rough edges tearing the cloth and causing the piece of cloth to adhere to it. It is not uncommon to find a piece of shell in the depths of the wound with a piece of cloth wrapped around it. A large piece of shell is apt to carry into the wound a large piece of cloth, and a similar condition is produced by a large number of smaller projectiles.

6. When the contaminated foreign body is carried into the depths of the wound and remains there, infection is much more apt to develop than when the wound is "through-and-through." The rarity of gas infection in civil life among accidents in the same agricultural area may be largely explained by the fact that the agent causing the wound does not as a rule remain in the wound. Multiple

wounds, comminution of bone, extensive laceration of soft parts are lesions exposed mostly to infection. The lacerated, infiltrated and devitalized muscles are the favorite starting place for gas gangrene. A cavity filled with clots, with muscular débris in process of autolysis, presents an admirable culture medium for the bacteria carried therein.

Lack of oxygen supply of the blood favors the development of the anaerobic bacteria. Restriction of the blood supply by the pressure of a hæmatoma, by a tourniquet, or by the ligation of a large vessel favor the development of infection by the lack of oxygen. Lack of oxygen supply from the air acts in a similar manner. A piece of shell is apt to make a small wound of entrance and then cause extensive injury to the deeper tissues. A deep wound, a wound closed over too quickly, either spontaneously or by misjudged surgery, may produce a condition favoring the production of anaerobic infection in that the access of oxygen is excluded.

7. There exists considerable confusion in the classification of the anaerobic flora found in gas infections. No specific bacillus is recognized as the cause, many varieties have been found and new anaerobes have been described. Which organism plays the most important part has not been decided. Attempts to limit certain clinical forms of the infection to certain species of infecting organism have added to the confusion. In France from a practical standpoint, the bacillus perfringens is usually considered as the prevailing organism in gas infections. This bacillus is recognized as a strain of Welch's bacillus aerogenes capsulatus, showing some technical differences from it. The perfringens is found in the large majority of infected wounds if not in all. West, at the Juilly ambulance, found bacilli resembling Welch bacilli morphologically and gram positive in cultures taken from ward blankets, dirt of the floors, soil of ward flower pots, and from the air. The air cultures were made by exposing veal media in Petri dishes in the wards overnight.

The question as to whether the perfringens produces a true septicæmia and circulates in the blood during life is undecided. It may be found in exceptional cases but is not found as a usual thing. Likewise observations on the toxines vary as to whether the intoxication produces death or whether a fatal issue is due to the absorption of the products of cytolysis.

In the vast majority of wounds the perfringens is associated with other organisms, anaerobic and aerobic. The Vibron septique of Pasteur, an inhabitant of the intestine of man and animals, is often met with in the wounds and is capable of giving rise to gas gangrene under favorable conditions. Costa and Troisier have described five groups of bacilli which range between the perfringens and the Vibron septique and which they name the bacilli lyticus. Sacquépée has isolated the bacillus of malignant gaseous œdema, and Weinberg and Seguin the bacillus œdematicus which is a different organism. The bacillus putrificus, having the same morphological character as the bacillus tetanus, is often found. To mention the bacillus A.B.C. of Weinberg, bacilli X.Y.Z. of Fleming, bacillus ramosus or bacillus diphtheroide of Wright, bacillus sporogenes of Metchnikoff, the bacillus of Doyen and Yamamouchi, bacillus fragilis and different streptococcic anaerobes of Distaco, is sufficient to close the list of anaerobes with the hope that future investigation may prove the identity of some of these varieties with one another.

Whatever differences of opinion there exists as to the morphology of these bacteria, all agree that the vitality, virulence, and power of penetration of these anaerobes are remarkable. Fiessinger has found them in an opened gangrenous wound at 4 centimeters depth between apparently healthy muscle fibers. No matter what antiseptic is used, the anaerobes may be found as long as there is dead tissue in the wound.

Besides the gas-producing bacteria, are found to a greater or less extent aerobic organisms. The streptococcus is found in nearly all the infected wounds at some period of their evolution. This organism is generally recognized to be the enterococcus, a regular inhabitant of the intestinal tract. The staphylococcus, normally present on the skin, fre-

quently accompanies the anaerobes. Various varieties of the cocci as the pneumococcus, diplococcus, flavus and crassus, have been described. The bacillus proteus and bacillus pyocyaneus are frequently met with in the later stages of the wound evolution. Varieties of the colon group, and even the bacillus typhosus and paratyphosus have been found in the wounds. Friedlander's bacillus is sometimes found, and to complete the list the coccobacillus Verodunensis of Besredka should be mentioned.

PHENOMENA OF WAR WOUNDS

The phenomena of war wounds have been ably described by Policard and Philip as a result of their study of the early infection of wounds.

1. Up to the fifth hour after the receipt of the wound, no reaction manifests itself. Microscopic examination shows the presence of blood-clots enclosing fibers of cloth, débris of the surrounding tissues, connective-tissue fibers torn, nuclei more or less altered, muscular fibers traumatized but no infiltration of leucocytes.

2. From the fifth to the ninth hour commences the reaction of the tissues. Migrating elements appear, the polynuclear neutrophiles, large mononuclear and small lymphocytes. This reaction of healthy tissues is feeble but at the same time the traumatized tissues show signs of degeneration.

3. From the ninth to the twelfth hour approximately, the appearance of bacteria is noted; large club-shaped organisms, gram positive, classified as bacillus perfringens or bacillus aerogenes capsulatus. These bacilli commence to appear in the immediate neighborhood of the cloth fibers and grow in the blood coagula which encloses them.

4. After about the twelfth hour three phenomena dependent one on the other are evolved simultaneously.

a. The bacilli multiply and spread out farther from the cloth fibers.

b. There is a production of polynuclear neutrophiles of which a small number perform the function of phagocytes. The reaction of defense of the tissues is clearly insufficient.

c. The leucocytes are altered and are transformed by degeneration into globules of pus but as the production of leucocytes is limited, the pus is not abundant.

5. These phenomena continue slowly at first but are accelerated from the twentieth to the thirty-sixth hour at which time the pus is fetid. Almost always at the forty-eighth hour the anaerobes are associated with aerobic organisms which favor their development by absorbing the oxygen of the media in which they are growing.

Time of appearance of gas infection. In general gas infection is an early symptom. It may appear in the first few hours after the receipt of injury and generally is seen in the first few days. Chalier has illustrated by a diagram the date of appearance of gas infection in his cases. The late appearance of gas infection should be noted. This may be produced by the ligation of a vessel for secondary hæmorrhage, the diminution of the blood supply allowing a flare-up of the infection. It may follow a reamputation or show itself in other cases difficult to explain.

Part of the body affected. In the great majority of cases it is the legs which are affected. Wounds of the thighs and buttocks are most apt to be soiled by mud and dejecta and are consequently more apt to become infected. Tuffier has stated that he has not noted a case of gas gangrene of wounds of the scalp, skull, or brain. He has not met with it in wounds of the face, jaws, or neck and exceptionally has he observed it in wounds of the thorax. Brodier, however, has reported a fatal case of gas gangrene of the scalp.

The following are the notes from a fatal case of infection of the neck:

Patient aged 24, wounded in the neck by a ball from *mitrailleuse* on September 25. First dressing applied one hour after receipt of wound. Incision of wound and drainage tube inserted the following day. Admitted to hospital on September 30 after a railroad journey of several hours. Temperature 102.2°, pulse 124. The right side of the neck showed considerable swelling and induration with a slight amount of crepitation. The wound of entrance was situated about midway along anterior margin of the sternomastoid. Radioscopic examination disclosed the bullet deeply situated in the neck. In spite of two operations for extraction of the bullet and for more extensive drainage, symptoms of gas gangrene developed rapidly and death resulted on October 6.

PATHOLOGICAL ANATOMY

The changes in the skin correspond to the stage and extent of the infection and vary from slight swelling to more or less extensive color changes. The modifications of color have been noted by many observers. The skin may be of a white porcelain appearance but there is almost always discoloration of

different hues—rose, yellow, brown, violet, bronze or copper color, black. These changes in color are either to be seen affecting a large area around the wound or they may show themselves in irregular patches following the lymphatic tracts. The color changes are probably dependent on destruction of small blood-vessels with resultant hæmorrhage into the skin. Vesicles of various sizes may be seen on the skin. These contain bloody serum which is usually sterile.

The region of the wound or the limb is increased in size and the anatomical outlines changed by the swelling. By incision gas and œdema are disclosed varying in predominence. The wound shows necrosis of the tissues. The surface is covered with a dirty greenish slough. A thin brown or chocolate colored discharge drains from the wound. Gas bubbles are mixed with this discharge or may be squeezed out by pressure on the tissues. Examination of the deeper structures shows that the affected muscle varies in appearance according to the extent of the process. In the earlier stages the affected muscles are pale or copper colored; in the more advanced stage they resemble an atelectatic lung and are black in the final stage. The muscles above and below the wound show œdematous infiltration. Gas bubbles may be observed along the intramuscular spaces. The odor is sharp, unpleasant, and quite characteristic.

The bacilli are found in great numbers in the tissue fluids. They are also present in the blood. The heart and large vessels show numbers of gas bubbles. They may also be found by microscopic examination of the muscles and liver.

SYMPTOMS AND CLINICAL FORMS

Much confusion exists in this subject. Different observers have described symptoms and forms as they have seen them, some near the trenches receiving the freshly wounded, others not seeing the wounded until several days have elapsed since the receipt of injury. Others have attempted to distinguish different varieties caused by different specific bacilli.

After a period varying from twelve hours to several days, the manifestations of a specific infection show themselves by pain, swelling, and tension of the wound, changes in the pulse and the mental condition. The subjective symptom of pain is most important and may be considered as a signal symptom. When a wounded man who has had his wound dressed and has been made comfortable complains that the dressing is too tight, it is well to take down the dressing and examine the wound. Palpation of the tissues shows increased tension and sometimes gas crepitation but this is not usually felt at an early stage. The swelling is limited to the region of the wound or to the entire limb and is caused by the œdema and later by gas and manifests itself as an œdematous or gaseous form according to the preponderance of one over the other. Rapidity of the pulse with or without irregularity is apt to be an early symptom. Changes in the mental state show themselves by a dulled, resigned, somewhat apathetic condition which may be noted in the early stages.

The wound discharges a thin, brownish pus and pressure may expel some gas. Discoloration of the skin shows itself in various hues varying from a porcelain appearance to black. These modifications of color show themselves around the wound or in irregular patches along the limb, the vesicles appearing suddenly but are often not present.

The presence of gas varies in intensity and is shown by percussion giving a tympanitic note and palpation reveals crepitation. A razor moved over the skin gives a special tone, called attention to by J. Quénu. The gas spreads rapidly within the first twenty-four hours of its appearance, commencing by developing around the wound then spreading up and down, following the vascular tracts to the axilla or groin where it may form air-pockets. Later it invades the flanks, scrotum, chest, or abdominal wall. In some cases it seems to arrest itself at Poupart's ligament. In those cases where the infection continues to spread, the limb becomes cold, sensation is lost, the pulse disappears and the local death of tissue progresses rapidly. The extension of the gangrene sometimes is rapid, lightning-like, *foudroyante* and in two or three hours signs of putrefaction are seen.

The odor is *sui generis*, nauseating and not

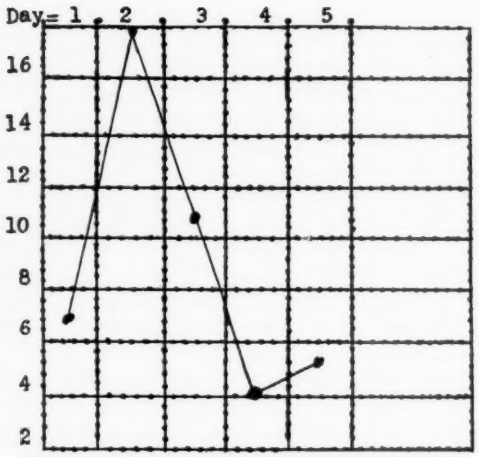


Fig. 1. Chart showing time of appearance of gas infection.

to be forgotten. It is the ammoniacal or fetid odor of decaying flesh. The odor is not present early and must be considered a late symptom. One should not wait for it to make a diagnosis. The odor diffuses itself quickly and permeates the ward. It is very persistent and resistant to disinfection.

Accompanying the local signs are the constitutional symptoms of fever and changes in the pulse. The fever is variable. The temperature is normal at first and ascends abruptly when signs of gas infection manifest themselves. It may descend in a few hours or become subnormal which is a symptom of bad omen. The pulse increases in rapidity and becomes smaller or irregular from the onset. The frequency of the pulse increases to the end even with a falling temperature. The pulse is a symptom of great importance and its character and rapidity is a good indication of the condition and gravity of the case. The appearance of the patient is rather typical in severe cases. The face has a leaden or subicteric hue, sometimes icteric. The mental condition is one of torpor and varies with periods of agitation. The mind may be remarkably clear and tranquil at the end and a soldier has even been known to ask for and smoke a cigarette an hour before death.

In the fatal cases the pulse becomes imperceptible, the respiration becomes shallow and irregular, the body becomes cold and death ensues with the patient in a state of collapse.

In favorable cases where proper treatment has been carried out, improvement is shown by the limitation of the infection. The œdema and gas become lessened and the skin assumes a more normal color. The discharge lessens in amount and becomes more like a simple suppuration. The sloughs separate from the wound and the margins show signs of granulations. The general condition of the patient improves but apprehension is felt on account of the slowness of the improvement. If the local condition improves, in a few days a change for the better should be noted in the pulse and facial expression of the patient.

CLINICAL FORMS

Much difference of opinion exists regarding the different clinical forms, and different methods of classification have been attempted. Thus, according to whether the œdema or gas predominates, different forms have been described. Where the clinical picture depends on so many elements as the depth and extent of the lesion, the degree and rapidity of the spread of infection, there is opportunity for divergent classifications. Numerous forms have been described but these forms correspond largely to the different stages of invasion.

One of the simplest classifications is that of Willems of the Belgian army, which is as follows:

1. The mild or superficial forms.
2. The severe or deep forms.

1. Under the mild forms are recognized the cutaneous and subcutaneous varieties. The cutaneous form shows itself as an œdematous zone around the wound with crepitation present and sometimes bronzing of the skin—*erysipele bronzé*. The condition is not dangerous but causes apprehension. Improvement is to be expected in a few days. A second superficial form called "malignant white erysipelas" has been described. This form is characterized by a white porcelain-like appearance of the skin, slight formation

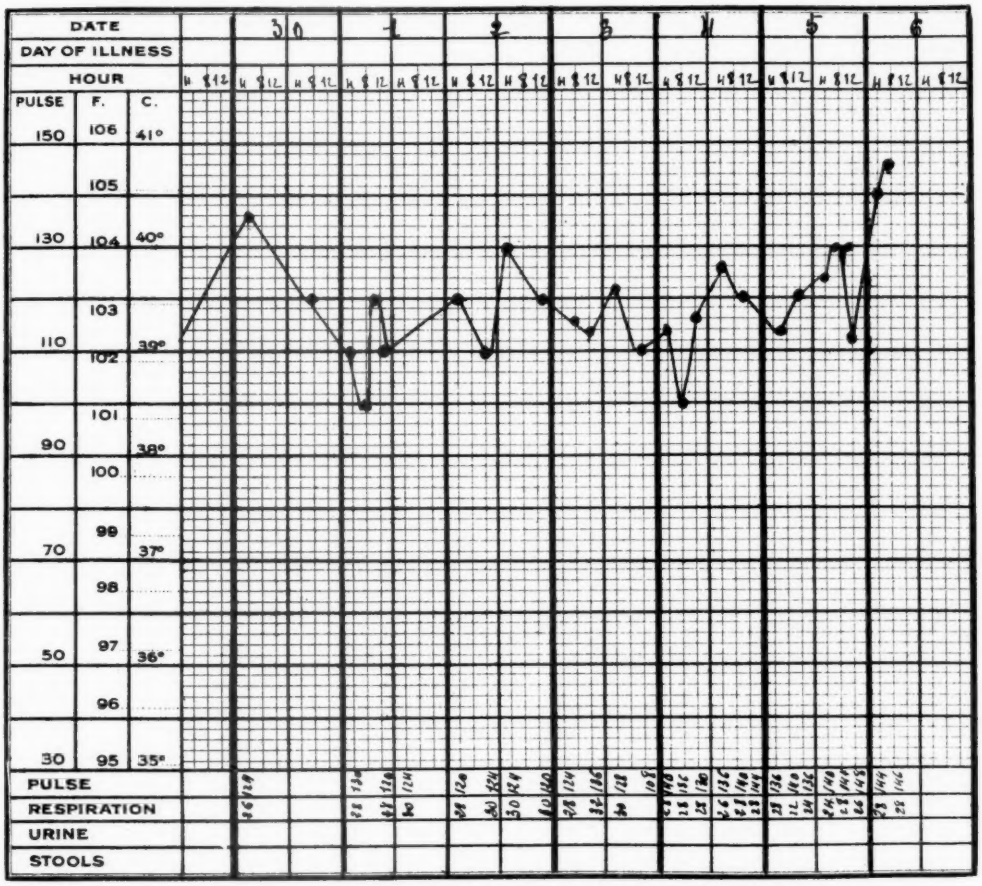


Fig. 2. Chart made in case having deeply situated bullet in neck.

of gas but marked œdema. The subcutaneous form is the "gaseous phlegmon or cellulitis." In this variety the infection is limited to the subcutaneous tissue and manifests itself by a zone of creptitation limited to the cellular tissue and shows no tendency to infiltrate the deeper tissues.

2. The severe or deep cases. These are characterized by œdema, and extensive gas formation spreading from a deep origin of muscular infection. The odor and brownish discharge are present. Severe general symptoms develop, the limb goes on to gangrene and the patient to death unless intervention is successful.

According to the predominence of symptoms among the severe cases have been distinguished "gas septicæmia" caused by the Vibron septique of Pasteur and "malignant gaseous œdema" dependent on a special anaerobe of Sacquépée. The first form is characterized by extensive gas infiltration, diffuse muscle gangrene, moderate and limited œdema. In the later form the œdema predominates, the area of muscular gangrene is circumscribed, and the gas is less evident.

DIAGNOSIS

As it is well known that almost every wound of modern trench warfare is contaminated

with gas bacilli, the mind of the surgeon is constantly alert to recognize gas infection. The eye recognizes the swelling and the skin discolorations, the fingers recognize the tension and crepitation, and the nose recognizes the odor. A well-defined case can hardly be mistaken. In early cases before crepitation has developed, there may be some difficulty in making a positive diagnosis. The early diagnosis is of the utmost importance as a few hours' hesitation is often fatal. The early discharge of thin, brownish fluid from the wound should be noted, and, in case of doubt, an incision should always be made. When crepitation is present the diagnosis is easy and can only be confused with a few conditions.

1. Wounds of the thorax with subcutaneous emphysema. The character of the wound, physical signs of pulmonary involvement, and extensiveness of the emphysema would readily lead to differentiation.

2. The entrance of air into the path of a projectile is differentiated by the lack of general symptoms, the limitation of the emphysematous area to the lesion and its rapid absorption.

3. Wounds of the rectum resulting in an emphysematous abscess. Prompt incision would clear up the diagnosis in this case.

4. The crepitation of a comminuted fracture might be mistaken but a careful examination would establish the diagnosis.

5. The crepitation under plaques of urticaria seen sometimes after injection of antitetanic serum might cause a momentary confusion.

The bacilli may readily be found microscopically in the wound secretions. The blade of a Paquelin cautery will set fire to the hydrogen sulphide of the gas and will have no effect on the gas of mechanical origin (Guénsot).

PROGNOSIS

The prognosis depends on whether the patient receives proper treatment early. A superficial infection or a deep infection receiving proper treatment in reasonable time, yield good hopes of recovery. The mortality is high in the deep forms and one can more often predict a fatal result in severe forms than a recovery. The œdematous forms have a worse prognosis than the gas forms. The so-called "white erysipelas" has a bad prognosis: almost certain death without amputation, 25 per cent recovery with amputation. Diffuse forms or cases in which the spots multiply rapidly offer little hope. Dyspnœa, icterus, and small rapid pulse are bad symptoms. It is difficult to designate the mortality in figures as collected statistics have not been published. There is wide latitude in the statistics of individual surgeons depending on the location of their post, the character of wounds treated, and the intervals of time that elapse between the receipt of the wound and the admission to the service. Mortality records would probably vary from 10 to 50 per cent depending on these and other factors.

It is noticeable that many more cases of gas infection are seen after heavy attacks when the wounded are transported in large numbers. This may be explained by the relatively longe period of time spent on the battlefield after being wounded, than in times of comparative inactivity. Also the vast numbers of wounded overcrowd the service and individuals do not receive the attention that they do at other times. It has not been infrequent at these times of great activity for masked cases of infection to develop on the trains and for these patients to arrive at their destination in a moribund condition.

TREATMENT

1. *Prophylactic measures regarding trench and personal hygiene.* Trench hygiene must be carried out as carefully as possible. To obviate the mud under foot, straw and pieces of wood are laid down in some trenches. Other trenches are built up with cement. The care of the latrines is indispensable. In spite of all precautions the presence of mud and dirt is inevitable in the present method of trench warfare. Fauntleroy has suggested disinfecting the trenches by coatings of whitewash.

Regarding the soldiers' uniforms, a firmer cloth like khaki would be easier to clean and would not be as favorable a habitat for bacteria. Some of the officers wear khaki but it is doubtful if any general change in the soldier's uniform will be made. It has been suggested that the cloth of the uniforms may be impregnated with some antiseptic which

may prevent the cloth fibers when carried into the wound from disseminating infection.

Maintaining individual cleanliness in trench warfare is difficult in times of comparative calm and impossible in times of activity. Bathing facilities are established within safe but accessible distances from the front lines. Some of these are large enough to handle a regiment in a few hours. Every man takes a hot shower bath, receives a close hair cut, and his clothes are sterilized by live steam. Before an attack soldiers are instructed to put on clean underclothes as far as possible.

The duration of time spent by the wounded on the muddy battlefield is undoubtedly a factor in the contamination of wounds and although this period is abridged as much as possible, yet more or less of this exposure is inevitable. The first-aid packet and iodine ampules have proved a failure as far as preventing infections in shell wounds. The dressing is too small for many of the wounds and the amount of iodine entirely inadequate. Also the fragment of shell and piece of cloth are carried into the wound and infect it and remain there beyond the reach of these measures. For rifle wounds the first-aid packet is undoubtedly useful.

Preventive vaccinotheraphy has been attempted but the results thus far have not been sufficient to establish confidence in this measure. Wright has prepared an antigangrenous vaccine to be used in mixed infections. Weinberg and Seguin have prepared an auto-pyo-vaccine. These measures to be at all successful must be practiced as early as possible after receipt of the wound.

2. *Prophylactic measures against gas bacillus infection or abortive treatment.* A certain number of cases of this infection are inevitable, especially when the number of wounded is very large and measures must be taken to reduce this number to a minimum. Early intervention within twelve hours is of utmost importance in preventing the infection. This intervention should consist of a thorough opening up and cleansing of the wound with the removal of dirt, pieces of projectile, clothing, and other foreign bodies that may be present. The attempt at removal of the projectile may not be successful without the aid of an X-ray apparatus and such a procedure is not always possible at such an early time. However, the lack of a radiogram should not prevent the above measures being carried out, such as the opening up of the wound and creating a condition unfavorable for anaerobic bacteria is most important. At the same time hæmostasis should be attended to and excision of damaged tissue that does not bleed and is doomed to slough, should be undertaken. In addition to these measures, the wound should be "disinfected." Opinions differ as to the best method to pursue in the first few hours—whether physiological or chemical. Those surgeons favoring physiological cleansing of the wound do so with the idea that an antiseptic is not useful on account of the lack of reactionary phenomena of the healthy tissues surrounding the wound up to the twelfth hour. Normal salt solution or sterilized sea water are the solutions used. For early chemical disinfection of the wound probably the best results have been obtained by the use of Dakin's solution according to Carrel's method. The wound is thoroughly washed out with this solution and special rubber tubes are introduced into the wound and so arranged that fluid injected through the tubes will reach all parts of the wound. The skin is protected by pieces of gauze impregnated with vaseline

Fig. 3. Roentgenogram showing deeply situated bullet in neck.

which are spread over it. Gauze soaked in the hypochlorite solution is sometimes lightly packed around the tubes and serves to hold the tubes in position. Dependent drainage at the lowest level of the wound is not provided as this would interfere with the fluid diffusing itself and keeping all parts of the wound moist. The fluid is injected every two hours through these tubes, or a continuous drip may be arranged. This treatment has prevented the development of infection in many cases. When it is necessary to transport the wounded at an early stage, proper splints should be applied in cases of fracture and careful observation of the wounded should be made en route.

Although the contagiousness of the infection is not claimed yet isolation of gas gangrene cases is desirable as a prophylactic measure. The odor makes it worth while to remove such cases from the neighborhood of other patients. As flies may transmit infection from one wound to another, the presence of these pests should be abolished as fast as possible. For obvious reasons, rubber gloves should always be employed in dressings, and instruments should be thoroughly cleansed and sterilized. Soiled dressings should be placed at once upon removal in paper bags and burned.

3. *Active treatment of gas-bacillus infection.* When the condition is definitely established a swift, energetic and drastic line of treatment is called for. As fresh air and sunlight are important, the patient should be cared for if possible on a porch or veranda. There is no divergence of opinion as to the necessity of deep and thorough incisions which allow the escape of fluid and gas and expose the tissues to the air. As to the local treatment to institute afterward, there are many different opinions. The use of ether is much in vogue with French surgeons and is highly considered. Ether is poured into the wounds and the wounds are lightly packed with gauze which is moistened with ether several times a day and covered with some impermeable material. Iodoformed ether 5 per cent is recommended by some surgeons. In addition to packing the wound with gauze wet with this solution, a tube is placed in the depths of the wound and 10 cubic centimeters of the mixture injected every six or eight hours. The subcutaneous injection of ether by many small injections has also been used.

Quénu recommends the use of hot air at 800° for bad cases and claims good results from its use. Willems favors what he calls the physiological method. After proper incisions have been made, the patient is cared for in an open gallery, the wound is covered with only one thickness of gauze and receives a continuous irrigation of 5 per cent salt solution. The employment of this solution produces a profuse lymphorrhœa. The use of salt solution of different strengths has also been recommended by Sir A. E. Wright and especially in those cases where the abdomen is involved.

On account of its oxidizing power peroxide of hydrogen solutions were expected to act specially on the anaerobic bacteria. It has proved to be an excellent solution for cleansing a wound and for loosening up sloughs, but its action is too temporary to be of much value and its use has been largely discarded.

Probably the most consistently good results have been obtained by Carrel's method with the use of Dakin's solution as a continuous drip or as an injection every two hours. The solution of sodium hypochlorite is antiseptic and at the same time not irritating to the tissues and has the capacity for dissolving necrotic material. The antiseptic power of the solution is due to the chlorine present in an active state. As this method is a most valuable contribution to modern military surgery a description of the method of preparation of the solution is appended.

To prepare 10 litres of the solution weigh exactly, calcium chloride grammes 200, sodium carbonate (dry) grammes 100, sodium bicarbonate grammes 80.

1. Introduce into a flask of 12 litres capacity the 200 grammes of calcium chloride and 5 litres of plain water. Shake briskly two or three times and let the contents stand over night.

2. Dissolve without heating the sodium carbonate and bicarbonate in 5 litres of plain water.

3. Empty the solution of the salts of sodium at one stroke into the flask containing the calcium chloride mixture, shake briskly for a minute then let it stand to allow the calcium carbonate to form.

4. After half an hour siphon off the clear liquid and filter it through a filter paper. A clear fluid will be obtained which should be kept away from the light.

The solution is now ready for use. It contains approx-

Fig. 4. Case illustrating typical symptoms of gas-bacillus infection.

imately 0.5 per cent NaClO with small amounts of neutral salts of soda. It should be used within a week of the time of its preparation.

As a result of laboratory experimentation, Dr. Kenneth Taylor has recommended the use of quinine hydrochloride for gas infection cases, either in the form of wet dressings or as a continuous drip. For the former a 1 per cent solution is used and for the continuous irrigation 1/10 of 1 per cent solution, made up with saline solution or plain water. The 1 per cent solution has also been used for hypodermatic injection into the gangrenous tissue around the wound. This method has been favorably reported and has been used in a number of hospitals.

Early in the war there were expectations that injections of oxygen or hydrogen dioxide into the tissues would be the measure of specific value in this infection but this method has been entirely disappointing and it has been practically abandoned. The method is harmful as it creates false passages and a dangerous tension of the tissues and at the same time it precludes incision of the tissues which is a *sine qua non*.

To avoid the large incisions some French surgeons follow the advice of Michaux and after having made one or more deep incisions,

Fig. 5. Case treated by cautery method.

surround the inflamed area by a series of punctures with the actual cautery extending to the aponeurosis. Several cases treated in this manner have come under observation, but ignorance of the original condition precludes the formation as to the value of this proceeding.

Morestin's mixture of equal parts of formol, alcohol, and glycerine has an embalming action on the tissues and has been used for a temporary expedient.

It will not be necessary to examine into all the antiseptics that have been used and mention will merely be made of those that have shown themselves of some value.

Permanganate of potassium.
Labarraque's solution.
Javel water.
Chloride of zinc, 10 per cent.
Carbolic acid solution.
Iodine solution.
Arseno-benzol and galyl.
Turpentine 15 grammes of essence to 1000 of artificial serum.
Horse serum.
Artificial gastric juice.
Lactose.
Hypochlorous acid by intravenous injection.
Sodium benzoate and bicarbonate solution.
Magnesium chloride 25 grammes to 1000.
Magnesium sulphate (saturated solution).
Chlumsky's solution.
Menciere solution containing:
Acid benzoic, 1 gramme,
Guiacol, 5 grammes.
Alcohol, 4 grammes.
Water, 1 litre.

The grand number of these different agents shows the inefficiency of any one of them. None of them are of value without proper incision and this being provided, the benefit of the solutions is probably due in a large measure to their mechanical cleansing of the wound.

The use of serum therapy is considered a disappointment. Delbet, however, has reported favorable results from the use of Weinberg's and Sequin's serum antiperfringens. If, in spite of the treatment outlined, the infection continues, it must be followed up by further incisions which may be successful. When a wounded man is received with a limb in a condition of frank gangrene or when the above-described measures have failed, amputation must be resorted to as a last measure. The question of amputation is often a difficult one to decide and requires considerable judgment. One should not wait until the extension of the process has reached such a point and the general condition of the patient is such, that intervention becomes a hopeless procedure. At the same time one should not amputate because some gas has been disclosed about the wound. No fixed rule can be laid down as to when to amputate as every case must be judged on its own merits. In general it may be said that a combination of general and local symptoms furnishes a picture that decides the question in the mind of the surgeon. The weakening of the body resistance as shown by the bad color, mental condition, and increased rapidity of the pulse combined with local symptoms of progressive gangrene as shown by increasing discoloration of the skin, œdema, and gas formation together with coldness of the limb and absence of pulsation of the vessels, indicate the gravity of the condition which demands action. To have hope of success amputation must be decided on while there is a chance of securing a good result.

Amputation when decided on should be performed speedily and shock should be combated as much as possible; the circulation may be stimulated by injections of camphorated oil, ether, adrenalin or strophanthin, but the best stimulant is hot saline solution given by hypodermoclysis. This is best given by two needles placed in the subcutaneous tissue of the pectoral region. This injection to be effective should be begun as soon as the patient is on the operating table and the salt solution should be in process of absorption at the time the operation is commenced. No time should be lost in lengthy measures for sterilizing the skin. The application of tincture of iodine or alcohol is sufficient. Gas and oxygen is the anæsthetic *par excellence*, its rapidity of action and lack of after depression demonstrating its superiority.

It is customary to amputate by the classical method of Celsus by which all the tissues are rapidly divided at the same level. The wound is left wide open. Sometimes the incision must be made through diseased tissue and secondary incisions should be made for drainage. The flap method may be used in certain cases in which the situation of the wound permits the saving of some skin and a longer length of limb. In such cases the flaps should be left wide open. In general the Celsus method is speedier and safer and is in more general use for desperate cases. A secondary operation may be necessary for improving the stump at a later period but that is a matter of comparatively little importance.

The patient should be well protected from exposure and artificial heat should be applied. The hypodermocylsis should be maintained after the patient is returned to bed or it may be discontinued and saline solution administered by the rectum by Murphy's method. The wound should be dressed openly as the original wound. The edges may develop gangrene with sloughing of the muscles. Sometimes the sacrifice of the limb is not successful in saving life, the gangrenous process continues, the œdema extends, and the patient succumbs in a few hours or days.

In cases that survive when the condition of the stump improves somewhat, the retraction of the skin can be prevented to a large extent by the use of "skin retraction." This consists in the use of four broad bands of adhesive plaster applied to the stump longitudinally or bands of flannel or some other mate-

rial may be glued to the skin by Huesser's glue. These bands are attached to a piece of wood from the center of which a cord runs over a pully attached at the foot of the bed. A weight of two or three kilos attached to the end of the cord is usually sufficient. In order to dress the stump, the bands are detached from the wooden cross-piece and laid back.

SUMMARY

1. Modern trench warfare with the accompanying difficulties in providing cleanliness exposes a large proportion of wounded to the dangers of gas-bacillus infection.

2. The majority of cases follow shell wounds when a piece of contaminated clothing is carried into the depths of the wound by the projectile.

3. Among the varieties of micro-organisms present in the wounds, the bacilli perfringens, are generally accepted as the causative organisms. These bacilli appear in the wound from the ninth to the twelfth hour. The aerobic bacteria appear about the forty-eighth hour.

4. The symptoms of the infection appear early, usually on the second day.

5. The parts of the body most often affected are the legs on account of the likelihood of their becoming contaminated by dirt and fæcal matter.

6. It is of vital importance that the diagnosis be made early.

7. Pain, swelling, and tension of the wound with rapidity of the pulse are important early symptoms.

8. Vesicles, discoloration of the skin, gas formation and odor should be considered later symptoms.

9. The prognosis depends on whether the patient receives proper early treatment.

10. Trench hygiene and personal cleanliness are vital prophylactic measures. Early incision of the wound with removal of the foreign bodies, cleansing of the wound and excision of damaged tissue doomed to slough are the correct surgical procedure of prevention.

11. When the infection is once established, well placed, deep incisions exposing the deeper tissues to the air, are indispensable.

12. For the clinical treatment of the wound, Dakin's solution has given the best results.

13. Amputation must be resorted to in many cases and should not be delayed beyond the proper period.

THE OPERATIVE TREATMENT OF INACCESSIBLE VESICOVAGINAL FISTULÆ[1]

By GEORGE GRAY WARD, Jr., M.D., F.A.C.S., New York

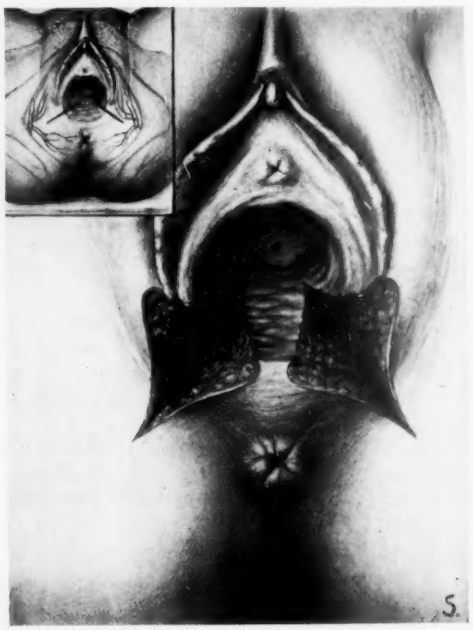
SINCE Hippocrates first recorded a case of vesicovaginal fistula, surgeons have striven to conquer this most distressing injury. Sims, by developing a correct technique, placed the problem on a sound basis, so that a large number of these unfortunates could be relieved of their sufferings, while Mackenrodt, by his contributions to vaginal surgery, scored a distinct advance in enabling the surgeon to repair the injury with greater certainty and ease.

Although the majority of vesicovaginal fistulæ can now be cured with comparative facility, still there are cases which tax to the utmost the ingenuity and skill of the cleverest operators, particularly cases where there has been an extensive loss of tissue, and those which are difficult to close because of their inaccessibility. It is this latter type of injury that I wish to bring to your attention.

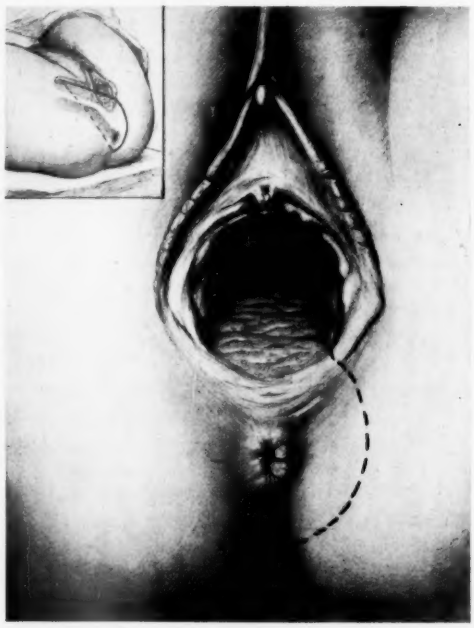
The inaccessible vesicovaginal fistula is not uncommon today, and it is frequently the result of an injury occurring during a panhysterectomy.

Sampson, in a study of cases at Johns Hopkins, found that accidental injury to the bladder during operations for carcinoma uteri, occurred in 19 out of 158 hysterectomies, about 12 per cent.

Again the cautery operation for carcinoma of the uterus, recently popularized by Percy, is a common cause of an injury to the bladder wall high up in the region of its attachment to the uterus, and the resulting cicatricial tissue at the site of the cauterization adds to the difficulty of the repair. The recent de-



1. Lateral vaginoperineal incisions, as made by Duehrrsen and others.



2. Schuchardt's incision outlined.

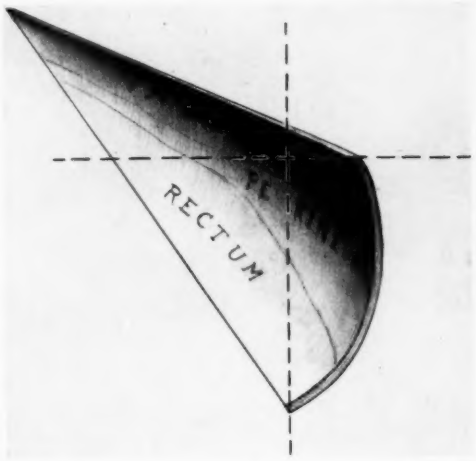
Read before the Clinical Congress of Surgeons of North America, Philadelphia, October 23–26, 1916.

velopment and extensive employment of the Wertheim operation and the Percy cauterization undoubtedly accounts for the more frequent occurrence of these inaccessible fistulæ in recent years.

This type of fistula is usually not large in size, but it is situated in the vault of an atrophied and contracted vagina, and is imbedded in the scar tissue which occupies the former site of the cervix.

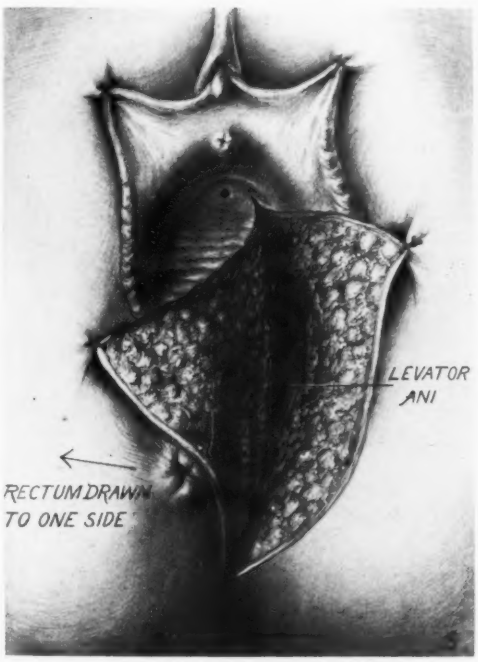
Inaccessible fistulæ have been attacked by many routes with varying degrees of success, in the endeavor to avoid that acknowledgment of defeat: colpocleisis. These avenues of attack may be grouped into two classes, those which are suprapubic and those which approach the fistula from below.

The suprapubic type of operation was first used by Trendelenburg in 1890, and von Dittel, Frank, Kelly, and many others have been advocates of this route. The extent to which Trendelenburg's operation came into use may be gathered from the fact that from 1890 to 1904 some 27 cases are reported in the literature.



3. Geometric figure of the plane of the incision.

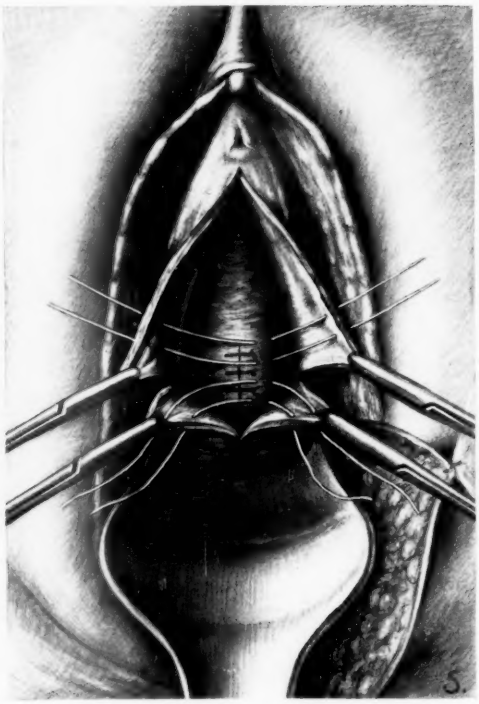
At the best the suprapubic operation



4. Schuchardt's incision completed (drawn from life).

5. Commencement of mobilization of the bladder.

6. Displacement downward of the bladder by means of a sound and sutures placed in fistula.



7. Vaginal sutures *in situ*.

is more severe and has a greater mortality than the vaginal operation. In many cases it is impracticable owing to fat abdominal walls. Coincident with the development of the suprapubic operation, distinct improvements have been made in the methods of attack by the vagina, so that the necessity for the employment of the dangerous operation has been greatly reduced. In 1902 Kelly advocated the employment of the knee-chest posture in order to obtain a good exposure of the vaginal vault, and the opening of the peritoneal cavity widely from side to side in the line of the transverse scar, so as to free the bladder and render it mobile. He then placed a large gauze pad with a tape in the peritoneal cavity and used it as a tractor to bring the bladder within reach.

A decided objection to this method is the danger of infected urine escaping into the peritoneal cavity.

In 1910, I published the method I had successfully employed in two cases, the guiding principles in the technique being the thorough and extensive separation of the bladder base from the anterior vaginal wall and then from the adhesions above the vault, and the displacement of the now movable bladder downward through the large vaginal incision, so as to bring the fistulous opening within easy reach.

This was accomplished by —

1. The employment of deep paravaginal incisions to render the field of operation more accessible.

2. A longitudinal median incision of the anterior vaginal wall extending from the urethra through and beyond the fistula, and a lateral incision across the full width of the vaginal vault. Then the thorough separation of the base of the bladder from the vagina and adhesions, being particular to commence the

dissection in the lower vagina, where there is an absence of scar tissue, in order to establish the line of cleavage.

3. Displacement of the bladder into the vaginal cavity by means of a sound passed through the urethra.

4. Suturing the opening in the bladder with catgut, and closing the vaginal incision with silkworm gut, being careful to catch the base of the bladder to one side of the site of the fistula, so as to bring the lines of suturing in different planes.

In 1913 Kelly in a further contribution advocates the same procedure as in 1902 but uses the lithotomy position instead of the knee-chest, and states that it is not always necessary to open the peritoneal cavity.

The method to be employed in each case must of course be determined by a careful study of the conditions present. In some cases the suprapubic method may be the only choice, in others a combined operation may be necessary, but the vaginal route should be tried first, provided it promises a fair chance of success.

I wish to emphasize a few points in the detail of the technique, which my further experience leads me to believe will help to a successful result. The essentials to success are —

1. Accessibility.
2. Free mobilization of the bladder.
3. Displacement downward of the bladder.
4. Correct suturing.

1. *Accessibility.* This is best obtained by the free use of the paravaginal incision of Schuchardt.

It is rather strange that in America a correct conception of this incision and appreciation of its value is rare. In the minds of many operators confusion exists between Schuchardt's incision and the ordinary lateral vaginoperineal incision, which is similar to a simple episiotomy. The two incisions are totally different and there is no comparison as to their effectiveness in procuring accessibility.

The simple straight vaginoperineal incision is superficial and much less extensive, as compared to Schuchardt's. Its length is limited by the pelvic wall and it is usually necessary to make one on each side of the perineum.

It is rarely necessary to make a second incision when Schuchardt's method is employed, and if properly made it causes no injury to important vessels or nerves; while the simpler incision, if extended toward the pubic ramus far enough to give sufficient working room, may injure the lower end of the bulb and the internal pubic and inferior hæmorrhoidal vessels and nerves.

Schuchardt first described his incision in 1893 for the radical vaginal extirpation of the carcinomatous uterus, and Schauta and others have adopted it in their vaginal operations for cancer.

In 1896 he advocated its employment for other conditions besides carcinoma of the uterus, and reported a case of its successful use in rendering accessible a double vesicovaginal fistula which was fixed in scar tissue high in the vagina. In 1901 he contributed a further study of his incision with an anatomical report by Waldeyer.

Vaginoperineal incisions have been employed by many operators prior to Schuchardt's description of his operation in 1893, notably Duehrrsen, Leopold, Chaput, Picque, and others, but as Sinclair remarks, it is not fair to speak of Schuchardt's method as a mere extension of these incisions; it is a distinctly beneficial addition to the resources of operative gynecology. Sinclair made Schuchardt's incision on the cadaver and had the anatomical relations studied by Young.

Doederlein and Kroenig state, "Schuchardt worked out an operation of his own which has proved to possess extraordinary advantages in the extirpation of carcinoma . . . . special attention must be called to the fact that Schuchardt's incision differs essentially from these lateral incisions, and that it increases to quite an unexpected extent the facilities of access to the uterus and its vicinity."

Gellhorn says: "The effect of the paravaginal incision is surprising. In place of a vaginal tube we have before us a shallow excavation not deeper than one inch."

The value of this incision as a means of procuring accessibility to the upper vagina and pelvic cavity is shown by the fact that

in Schauta's clinic from 1890 to 1900 the operability of cancer cases by the old methods was 15.1 per cent, while in 1901 in 30 cases done with the Schuchardt technique the operability was 36.2 per cent.

I can but echo these statements and add that one must see the marvelous change from inaccessibility to accessibility which Schuchardt's incision produces to fully appreciate its value in these cases.

Duehrrsen claimed that he had recommended the same incision three years prior to Schuchardt, but a study of his paper shows that he described the straight vaginoperineal incision, which is directed toward the ischium and is but two to three centimeters in depth.

In 1892, Chaput described an incision similar to that of Duehrrsen, before the Congrès Français de Chirurgie, which he designated as a "colpoperineotomie laterale," and in the discussion Picque stated he had utilized it several times for high vesicovaginal fistulæ.

The vaginoperineal incision of Duehrrsen, as described by him in 1889, commenced 6 to 7 centimeters within the vagina at the junction of the posterior with the lateral wall, and extends in a straight line for a similar distance on the skin toward the ischium (Fig. 1).

Schuchardt, in his later description of his operation, describes the site of the incision as a triangle, one side of which is on the vaginal wall, the other on the skin from the junction of the middle and lower third of the labia majora to a point a finger's breadth posterior to the anus near the middle line, and the base forms a line extending obliquely from the upper end of the incision on the vagina to a point just posterior to the anus. It lies from within outward, partly in paravaginal and in pararectal tissue, the fat of the ischiorectal fossa, and in the subcutaneous tissue. The surface of this triangle is curved on its long axis with its concavity toward the rectum (see Figs. 2, 3 and 4).

Technique. The incision is made preferably on the left side, as it is easier for right-handed operators. The left labium is put on the stretch and is divided at the junction of its middle and posterior third. The incision is then extended up the whole length of the vaginal tube at the junction of the posterior and lateral walls, completely splitting the vaginal canal. It is next continued on the cutaneous surface in a curve outside of and encircling the sphincter ani, the integrity of which is preserved, and terminates a finger's breadth posterior to the anus near the median line. The entire incision is then deepened in a curved direction enveloping the rectum, without injuring it, until the inner surface of the canal of the levator ani and coccygeus muscle and the depths of the ischiorectal fossa are plainly exposed. If the incision has been correctly made, that is with a sufficient curve, the levator muscle will not be cut, except the superficial fibers near their insertion into the coccyx and sphincter ani.

It will then be seen that the incision, while commencing laterally on the vaginal surface, terminates at its base near the median line posterior to the rectum, encircling that organ and consequently mobilizing it, so that it may be displaced to one side. Thus the incision, for all practical purposes, becomes a median one, lying in the longest diameter of the pelvic outlet, thereby obtaining the maximum amount of space. The incision divides the whole vaginal canal, the left labium, the skin of the perineum and lateral anal region down to the coccyx, the superficial fascia, the bulbo cavernosus and transversus perinei muscles, the lower part of the triangular ligament, the paravaginal and pararectal tissues, the outer fibers of the levator ani near their sphincter ani and coccygeal attachment, and the cellular tissue of the ischiorectal fossa. It passes below the vestibular bulb and Bartholin's gland.

Only the superficial branches of the perineal and inferior hæmorrhoidal vessels and nerves are divided, and hæmorrhage is readily controlled with a few ligatures.

In spite of the extent of the incision, no tissue of importance is injured, and the wound unites readily if closed with a layer of buried and external sutures. A rubber tissue drain should be placed at the lower angle of the incision extending into the ischiorectal fossa.

2. *Free mobilization of the bladder.* To

Mackenrodt belongs the credit of first teaching us the possibility of making a wide separation of the bladder from the vagina and uterus with safety, and it is this principle that enables us to bring within reach the fistulæ which are situated in the vaginal vault.

It is interesting to note that in 1839, Hayward, a New England surgeon, stated that he dissected the vaginal wall from the bladder at the site of a fistula, although to a limited extent.

The technique of the wide separation of the bladder from the vagina is practically that of the modern operation for cystocele, with a more extensive dissection at the vaginal vault. In cases in which the bladder is extensively adherent to dense cicatricial tissue, a transverse incision extending the full width of the vault is essential in order to free it sufficiently.

I would not hesitate to freely open the peritoneal cavity as recommended by Kelly, but so far I have not found it necessary. It is wise to bear in mind the possibility of the proximity of an adherent loop of intestine where the uterus has been removed.

The point in the technique which I wish to emphasize is that in separating the bladder base from the vagina, the dissection should commence at the outer end of the anteroposterior incision near the meatus urinaris (as indicated in Fig. 5), where there is an absence of scar tissue, and where it is a simple matter to find the line of cleavage between the bladder wall and the vagina. This having been established, the separation is carried upward and outward until the cicatricial tissue in the region of the fistula is encountered, when the dissection progresses, partly by the use of the gauze covered finger, and partly by snipping with round pointed scissors, with a fair degree of safety by reason of the line of cleavage having been first determined, and by the use of a sound in the bladder as a guide.

3. *Displacement downward of the bladder.* If care and patience are used to free the bladder laterally to the utmost limit, not only at the vault, but also throughout the length of the anterior vaginal wall, the next procedure, that of dislocating the bladder-wall downward so as to bring the site of the fistula within easy reach, will be greatly facilitated.

The employment of an instrument introduced into the bladder through the urethra for this purpose, and to act as a counterpoint, has been advocated by Pasteau of France. He has devised a special instrument for the purpose, but I can see little advantage in it over a sound. The idea is not original with him, however, as Hayward, to whom I have previously referred, in his paper written in 1839, describes introducing a large bougie into the urethra, carrying it back as far as the fistula, and using it to bring the bladder downward and forward so that the opening is brought fairly into view.

I consider that the employment of an instrument in the bladder used as a lever and counterpoint is a decided aid, and I have found a straight male sound (No. 28, French scale) to be most satisfactory for this purpose (Fig. 6).

4. *Correct suturing.* Catgut should be used for closing the opening in the bladder-wall. I have found No. 1 chromic gut suitable for this purpose. The needles should be very short, curved, round pointed, and strong. These sutures should penetrate the muscular coat of the bladder only, and have the effect of turning in the edges of the fistula. A second layer may be used to advantage in some cases.

The vaginal incision at the vault should be closed with silkworm-gut sutures, an important point being to catch with each stitch the base of the bladder to one side and beyond the fistula, so that when tied the lines of suturing will be brought in different planes, and will avoid dead space (Fig. 7).

The bladder should be drained with a self-retaining catheter, or be frequently catheterized for a period of six days.

REPORT OF CASES

I know of eleven cases in which this technique has been employed, all with a successful result.

Parham, of New Orleans, has published a case resulting from a panhysterectomy for carcinoma, in which he successfully used this method, after two failures; the first operation

being done by the ordinary vaginal technique, and the second by the suprapubic transvesical method of Trendelenburg.

Ashton, in a personal communication, states that he has operated on three cases by this method, all with success, and he considers it not only good for high fistulæ with the surrounding parts fixed by adhesions, but in the light of his experience he believes that it facilitates the ease and certainty of technique, in fistulæ low down in the vagina.

Anspach has employed the operation in one case following hysterectomy, with a successful outcome.

I have recently had the pleasure of seeing Cullen do the operation on a difficult case, in which the uterus had been previously removed for carcinoma, with a cure.

My own experience in the repair of the inaccessible type of vesicovaginal fistula consists of five cases, all of which were successful. Two of the cases I have reported in my original paper.

CASE 3. Mrs. E. K., age 44, had a panhysterectomy in August, 1913, for an intraligamentous fibroid, and during the course of the operation the bladder was evidently injured, as shortly afterward she developed a leak in the vagina. I first saw her in November, 1913. Examination revealed a typical inaccessible vesicovaginal fistula. A hole the size of a pea which communicated with the bladder was situated in the vaginal vault in the transverse scar, which occupied the former site of the cervix. The cystoscope showed the opening in the upper part of the trigone near the left ureter. Although the patient had had two children, the pelvic floor was uninjured. I operated on November 20, 1913, making a typical Schuchardt's incision, carrying out the technique as described. The bladder was drained with a self-retaining catheter for six days.

A letter received in August, 1916, states that the fistula has remained closed ever since.

CASE 4. Mrs. P. D., age 32, an Italian woman, enormously fat, weighing over 200 pounds. She had a very difficult instrumental labor which had resulted in a large vesicovaginal fistula, the size and shape of a five cent piece, situated high up, its upper margin being in contact with the stump of the cervix which had been torn off. The uterus was firmly fixed in the pelvis and could not be drawn down a particle. Owing to the excessive amount of fat and the contracted vagina, the result of cicatricial tissue, the case was a most inaccessible one. I operated on November 20, 1915. The Schuchardt incision gave good access to the field of operation, but the size of the opening, the dense adhesions and a profuse capillary hæmorrhage, which continued throughout the operation, added greatly to the difficulty. It was the most difficult case I have experienced, but the closure was finally satisfactorily accomplished by the technique described. The bladder was drained with a catheter for 7 days. The result was all but perfect; a small hole the size of a pin head persisted in the middle of the vaginal wall in an accessible situation, and I closed it with comparative ease at a subsequent operation on February 5, 1916, by a simple denudation and suture.

The result has been a permanent cure.

CASE 5. Mrs. C. M., age 53, an Italian woman, very fat, presented herself at my clinic with a well advanced epithelioma of the cervix. The case would have been suitable for a Wertheim operation, as the uterus was not fixed and the broad ligaments did not appear to be infiltrated, but owing to her obesity, I employed the Percy cautery method on April 16, 1915. The tissues were satisfactorily cooked for one hour, the cautery iron penetrating to the fundus, the abdomen being first opened.

The patient made a good recovery but developed a small vesicovaginal fistula in the vault of the vagina, imbedded in the dense cicatrix. No sign of the cervix remained. On September 18, 1916, one year and five months after her operation, examination disclosed no evidence of a recurrence. The patient had retained her weight, looked well, felt well, did her own housework, and had no symptoms except the leak.

On September 25, 1916, I operated upon her to close the fistula by the technique I have described. The operation was not especially difficult, and the fistula was successfully closed.

SUMMARY

The points that I wish to emphasize in the closure of inaccessible vesicovaginal fistulæ by the vaginal route may be summarized as follows:

1. Schuchardt's incision is our most effective means of obtaining free access to the vaginal vault for operative procedures in difficult cases.

2. This incision should not be confounded with the ordinary straight lateral colpoperineotomy.

3. The incision is a distinct addition to the resources of operative gynecology.

4. Free mobilization of the bladder is an essential requisite to the successful closure of inaccessible vesicovaginal fistulæ.

5. Free mobilization of the bladder is most easily obtained by first establishing the

plane of cleavage between the uninjured vesicovaginal tissues.

6. Displacement of the bladder injury downward within reach by means of a sound in the bladder used as a lever and counterpoint, is a decided aid.

7. Care should be taken that the sutures are placed in the bladder and vaginal walls in such a manner that the lines of incision are not superimposed.

CONCLUSIONS

I wish to echo the statement of Jeff Miller that "Modern surgery furnishes no more striking illustration of the advances made in plastic technique than is shown in the methods now employed in bladder fistulæ," and I wish to emphasize the truism that the most successful surgeon of the future will be he who, with a wide knowledge of all the methods at his command, chooses the one which will be the most suited to the individual case.

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THE SURGICAL METHODS OF DEALING WITH PELVIC INFECTIONS[1]

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ALTHOUGH pelvic infections form no small a proportion of the cases coming under the care of the abdominal surgeon and often give him much anxiety, their consideration at medical meetings is frequently relegated to the background for some newer, more interesting, and yet less important topic. This evening I shall not attempt to cover the subject, but in the necessarily limited time at my disposal I wish to outline the methods that I have found most satisfactory in dealing with these infections.

The methods here described have not been developed by any one man, but are due to the gradual crystallization of the knowledge gained from the wide experience of many men and from the greater insight into the pathology of the various lesions that has come to us year by year.

THE METHOD OF HANDLING AN APPENDIX ABSCESS

An appendix abscess may or may not be pelvic. As it is on the border line, however, I shall describe briefly the method of treatment that has given me the greatest satisfaction. In the past considerable controversy has been waged as to whether the abscess should merely be opened and the appendix left behind, or whether the appendix should be removed at the same time. During the past ten years I have always found it possible to remove the appendix at the time the abscess was drained.

What is the usual site of an appendix abscess? It generally lies between the cæcum and the right lateral abdominal wall and, as a rule, is covered over by a corner of the omentum. It has been the retrocæcal position of the appendix that has enabled nature successfully to wall-off the inflamed area. Had the appendix been lying relatively free there would have most probably followed, in association with the inflammation and subsequent gangrene, a general peritoneal infection instead of a localized abscess, unless the appendix had become rolled up in the omentum.

How can we deal with the appendix abscess without spreading the infection? After making a gridiron or a longitudinal incision, as may be deemed most expedient by the individual surgeon, we at once encounter the adherent omentum. This is plastered over the surface of the cæcum, or may be lightly adherent where the cæcum joins the lateral abdominal wall. To attempt to wall-off the abscess area for the time is impossible. If gauze is packed upon the omentum, it will be like packing down upon a spring-board; and if too much pressure is exercised, the omentum where it is adherent to the abscess may tear away and pus will often trickle out from the abscess, run over the cæcum and escape between intestinal loops. We must, therefore, adopt a method that will enable us to completely wall off the abscess before it has been disturbed. This is readily accomplished by picking up the omentum just to the inner side of the cæcum, doubly ligating it (Fig. 1) and then cutting between the two rows of ligatures (Fig. 2). The healthy omentum is then pushed back into the abdomen, and the abscess to which the distal portion of the omentum is still attached is completely walled-off. Packing is also carried up toward the right renal pocket and down into the pelvis on the right. After the walling-off is complete and the edges of the abdominal incision are properly protected, the distal portion of the omentum which is adherent to the abscess may be gently pulled away, if it is only lightly adherent. This omentum often represents the cork of the abscess sac and pus at once commences to well up (Fig. 3). The pus is wiped out as rapidly as possible, and if we now draw the cæcum away from the abdominal wall, the appendix, or what remains of it, at once comes into view and can be removed. Sometimes the omentum is densely glued to the cæcum. In such cases

[1] Read before the Clinical Congress of Surgeons of North America, Philadelphia, October, 25, 1916.

the abscess is reached by bluntly dissecting the cæcum away from the abdominal wall, the adherent omentum not being disturbed.

One drain is laid to the floor of the abscess, one up in the right renal pocket, and one down in the right side of the pelvis. Where drainage alone is desired, I use a cigarette drain with little or no gauze protruding from the end. But where there is much capillary oozing this is of little value, because it is necessary to have the gauze come in direct contact with the bleeding area; otherwise bleeding will continue. On at least two occasions I have had to bring the patient back to the operating room, remove the completely covered cigarette drain and replace it with one that had an ample supply of exposed gauze at its inner or cæcal end. The direct application of the gauze to the oozing area is absolutely necessary to check the capillary oozing. Where a right rectus incision has been employed, it is usually wise to make a second incision in the right iliac fossa and to bring the drains out through it. The longitudinal incision is then closed.

THE METHOD OF DEALING WITH PUS TUBES

The greater number of pus tubes are probably due to gonococci. I say probably, because we rarely open an abdomen for an acute gonorrhœal infection, but prefer to employ cold or heat to the abdomen and use hot vaginal douches. The majority of the pus tubes we remove are quiescent and have been of long standing, and the organism responsible for the infection has long since died. And although a gonorrhœal infection has undoubtedly been the causative factor, we are gradually awaking to the fact that in many instances the pelvic trouble has dated back to an acute attack of appendicitis. In such cases the salpingitis may be limited entirely to the right side, or if both tubes be involved, the right tube shows more involvement than the left. Dr. J. E. Moore, of Minneapolis, and others have dwelt at length on this subject.

You are all so thoroughly familiar with the technique of the supravaginal removal of the uterus together with the tubes and ovaries that I shall omit any consideration of this part of the subject. In those cases in which the uterus, tubes, and ovaries form one conglomerate mass and in which a point of cleavage is almost out of the question, bisection of the uterus, as described by Howard A. Kelly, is of the greatest help. It not only reduces the time of operation by half, but enables one to do much cleaner work.

In many instances complete removal of the pelvic structures is absolutely necessary for the relief of the patient and cannot be avoided. Those of you who have spent years in gynecological dispensaries, however, fully realize the sad mental and physical condition of the many patients that have had their pelvic organs removed in early womanhood. It makes such a profound impression upon the young surgeon that in future he will bend every energy to the saving of the menstrual function of the patient, whenever feasible. It is often possible to save the uterus and one or both ovaries provided they are not too badly diseased, and provided that at the time of operation a small drain is placed in the pelvis and brought out through the vagina. I only wish to refer to two surgical points in the handling of pus tubes. In the first place, when removing a pus tube, it is always well to take away a wedge of the uterine cornu with the tube. Situated in the cornu around the lumen of the tube one frequently finds a few small glands. These occasionally become infected with the tube, giving rise to cornual abscesses. I have seen these reach 2 or 3 centimeters in diameter, and if they are left behind, further trouble is liable to occur. In the next place we occasionally find a large pus tube free throughout the greater part of its course but densely adherent to the pelvic floor. It not infrequently happens that the pelvic floor forms the cork, as it were, for the open fimbriated end of the tube (Fig. 4), and the minute one attempts to shell out the tube, there is an abundant escape of pus. In such a case, if one begins by removing a wedge of the uterine cornu with the inner end of the tube and then cuts across the mesosalpinx, it is possible to draw the tube up until it is almost perpendicular. It is then possible to surround it almost completely with gauze (Fig. 5). It can then be shelled

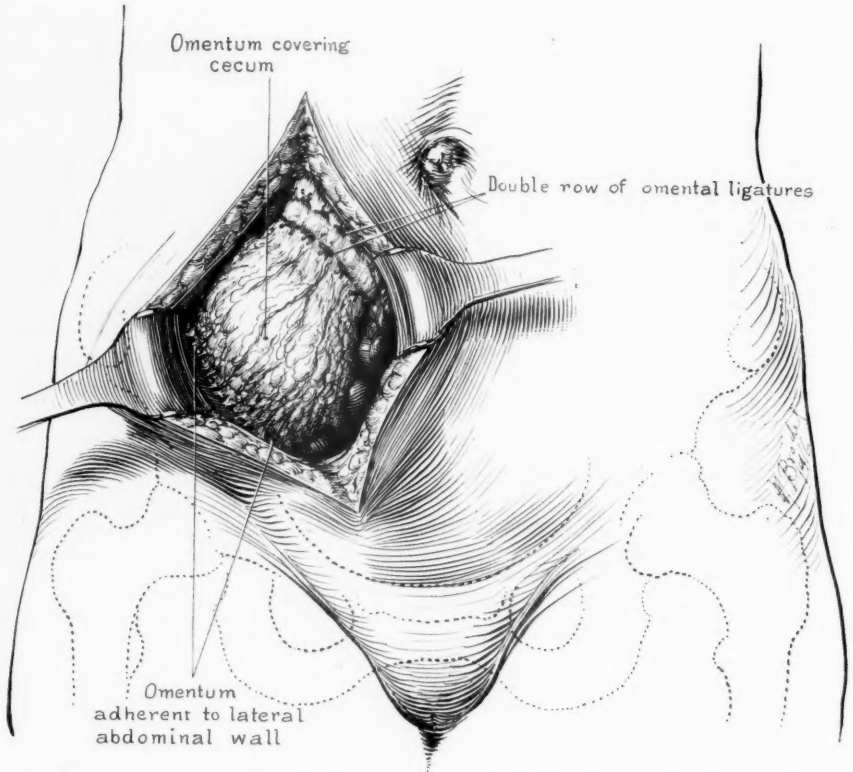

Fig. 1. Step 1 in the treatment of an appendix abscess. In the picture a right rectus incision has been made and the omentum is found adherent over the cæcum and to the right lateral abdominal wall. No attempt has been made to loosen up the omentum. It has been doubly ligated as indicated by the two rows of sutures and will now be cut across between the two rows. For the subsequent steps see Figs. 2 and 3.

out with a minimal escape of pus and without soiling the surrounding pelvic structures. Of course, the general pelvic cavity must be properly protected before the pelvis is explored. This small point in the technique renders the operation a much simpler and cleaner one.

THE PLACING OF A PELVIC DRAIN

This is often a very simple procedure, but now and then is somewhat difficult. When the necessary pelvic work has been finished and there is capillary oozing from the pelvic floor, or where owing to the nature of the case there is danger of infection, a pelvic drain is a great comfort to the surgeon. With the patient in the Trendelenburg position and with the pelvis carefully walled-off, an assistant wipes out the vagina and with a pair of long Kelly forceps presses the posterior vaginal wall up into the pelvis until the elevation on the pelvic floor resembles the peak of a small tent. The operator then cuts down upon the forceps from above. As soon as the tip of the forceps comes through into the pelvis the vaginal opening is made wider either by spreading the forceps from below or by introducing a uterine dilator from above. A large tablespoon (Fig. 6) held against the posterior surface of the pelvic wall acts as an excellent shield or protector for the rectum while the vaginal forceps grasp the cigarette drain and draw it as far into the vagina as the

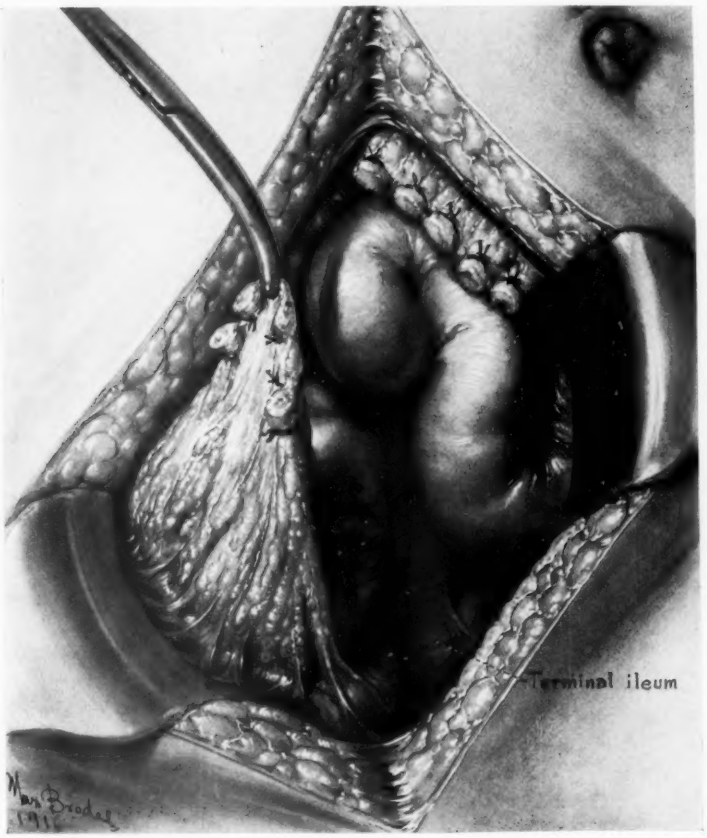

Fig. 2. Step 2 in the treatment of an appendix abscess. The greater portion of the omentum after ligation has been pushed back into the abdomen. The operator can now readily place a cofferdam of gauze above, on the inner side of and below the cæcum, thus effectually preventing the escape of pus into the surrounding general peritoneal cavity.

operator deems wise. The surgeon now fits the free gauze ends into the pelvis, cutting off any excess that may be necessary, and so places the drain that, if possible, the gauze does not come in contact with any small bowel.

While this method of placing a pelvic drain seems to be almost ideal, a good deal of care must be exercised. On one occasion an assistant had considerable difficulty in bringing the ends of the forceps up in the vaginal vault behind the cervix. Finally he was successful, but when the cut was made, a little water escaped. He had carried the forceps in through the urethra and by his pressure had carried the bladder through the broad ligament and up behind the cervix. In another case an assistant was asked if his forceps were in the vagina and answered in the affirmative. They appeared in the usual place and were cut down upon. Subsequent examination showed that he had introduced his forceps into the rectum instead of into the vagina. I happened to be the operator in each instance. Fortunately in both of these patients the accidental openings were promptly closed and both made excellent recoveries.

Fig. 3. Step 3 in the treatment of an appendix abscess. The portion of the omentum adherent to the cæcum and shown in Fig. 2 has been removed, and the cæcum gradually separated from its attachment to the anterior and lateral abdominal wall. The pus as it wells up is at once caught with sponges and removed. When the abscess sac has been emptied, the appendix, or what remains of it, is removed. Drains are now laid upward toward the right renal pocket, down to the bottom of the abscess sac, and into the right side of the pelvis next to the pelvic wall. The ends of all of these drains are brought out through an oblique incision in the right iliac fossa.

I have recorded these cases in detail elsewhere.[1] In all cases the forceps should be introduced into the vagina under sight and not by sense of touch.

THE REMOVAL OF VAGINAL DRAINS AFTER ABDOMINAL OPERATIONS

A vaginal drain is usually not disturbed for at least four or five days, unless there are symptoms suggesting that it has become clogged or that it is too tightly grasped by the vaginal opening. If this is suspected the drain is merely drawn down for about half an inch. At the end of the fourth or fifth day half of it is usually removed and on the following day the remainder is taken out.

As was said before, when the drain is being laid in the pelvis at the time of operation, care is taken to so protect it that loops of small

[1] Kelly and Cullen. Myomata of the Uterus, p. 624.

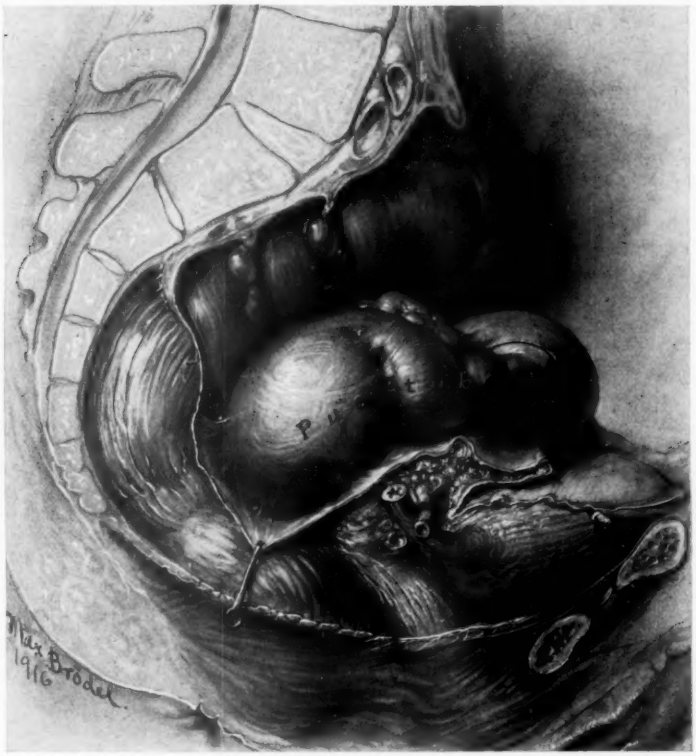

Fig. 4. The removal of a large pus tube which is firmly glued to the pelvic floor. Such a tube frequently has an open fimbriated extremity and the peritoneum of the pelvic floor with which it is intimately blended by adhesions prevents the escape of the pus. Just as soon, however, as any attempt is made to loosen up the outer end of the tube, the pus escapes. In such a case if the tube is loosened up from within outward, in other words, if the inner end of the tube and at the same time a wedge of the uterine cornu are cut free and the mesosalpinx then divided, the tube can be loosened up as far as its outer ends without any escape of pus. The next step is shown in Fig. 5.

bowel will not come in contact with it. Now and then, however, a loop of bowel does come in contact with the gauze, and if the operator attempts to remove the drain on the second or third day, he may be chagrined to find that he has drawn a loop of bowel down into the vagina with the gauze. Several years ago I saw such an accident occur. The surgeon at once pushed the loop back into the pelvis, but the patient immediately showed signs of collapse and died in a few hours. By the fourth or fifth day the gauze, even if it has been in contact with the bowel will have become loosened so that there is little danger that the bowel will come down with the drain. This complication must, however, always be borne in mind.

THE METHOD OF DEALING WITH EXTENSIVE PELVIC INFECTIONS

In order that we may satisfactorily treat cases of extensive pelvic infections, it is absolutely necessary that we have a composite view, as it were, of how the pelvic infection has developed. The inflammation invades the mucosa of the cervix, rapidly extends to

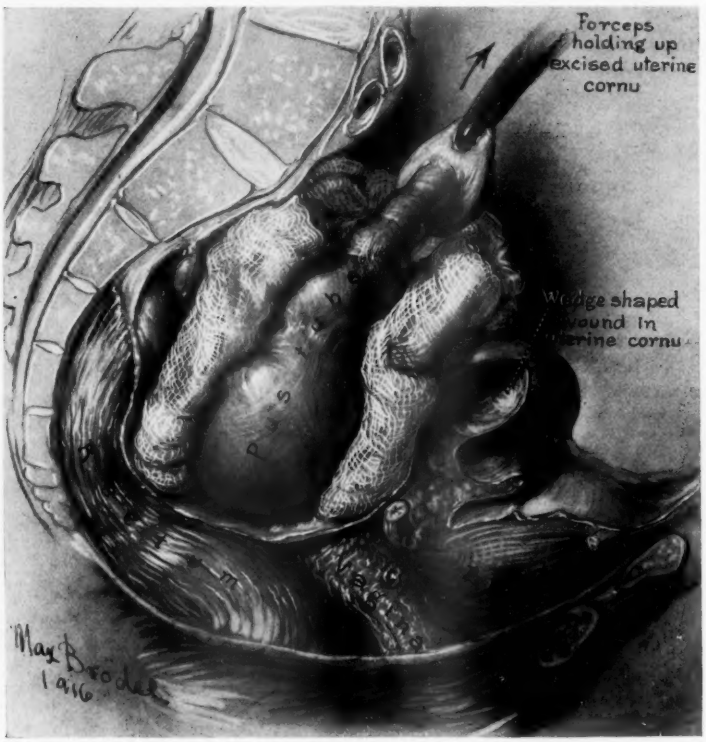

Fig. 5. The removal of a pus tube. After the tube has been freed from the uterus and mesosalpinx, it can be lifted up. It is now surrounded on all sides with gauze and is then shelled out from the pelvic floor. Pus will escape, but only for a moment, and the abscess is effectually walled-off from the surrounding pelvic structures.

that lining the cavity of the uterus, and by continuity involves both fallopian tubes. The tubes may become sealed and the inflammation end there. If one or both tubes are open, however, pus trickles into the cavity of the pelvis and an abscess develops there.

The ovaries with the development of the corpora lutea are subject to considerable variation in size, and here and there may show breaks due to the rupture of graafian follicles. At such points the ovaries may become infected from the widespread pelvic infection, unilateral or bilateral ovarian abscesses resulting. Naturally everything that comes in contact with the inflamed pelvic structures becomes adherent, and consequently the omentum, loops of small bowel, the cæcum and rectum are often more or less firmly glued to the pelvic contents.

In cases in which on vaginal examination the vaginal vault is board-like or where there is marked bulging into the vagina, the proper treatment, namely, vaginal drainage, is perfectly evident (Fig. 7). The cervix is drawn forward, the vaginal mucosa directly behind the cervix is grasped with a pair of dissecting forceps and the vaginal mucosa cut with scissors. A blunt pair of long Kelly forceps or a uterine dilator can be then readily pushed through the intervening tissue and into the abscess. I feel that it is a mistake to push a sharp instrument into the abscess, as there is always a danger of injuring some structure that has become adherent in the pel-

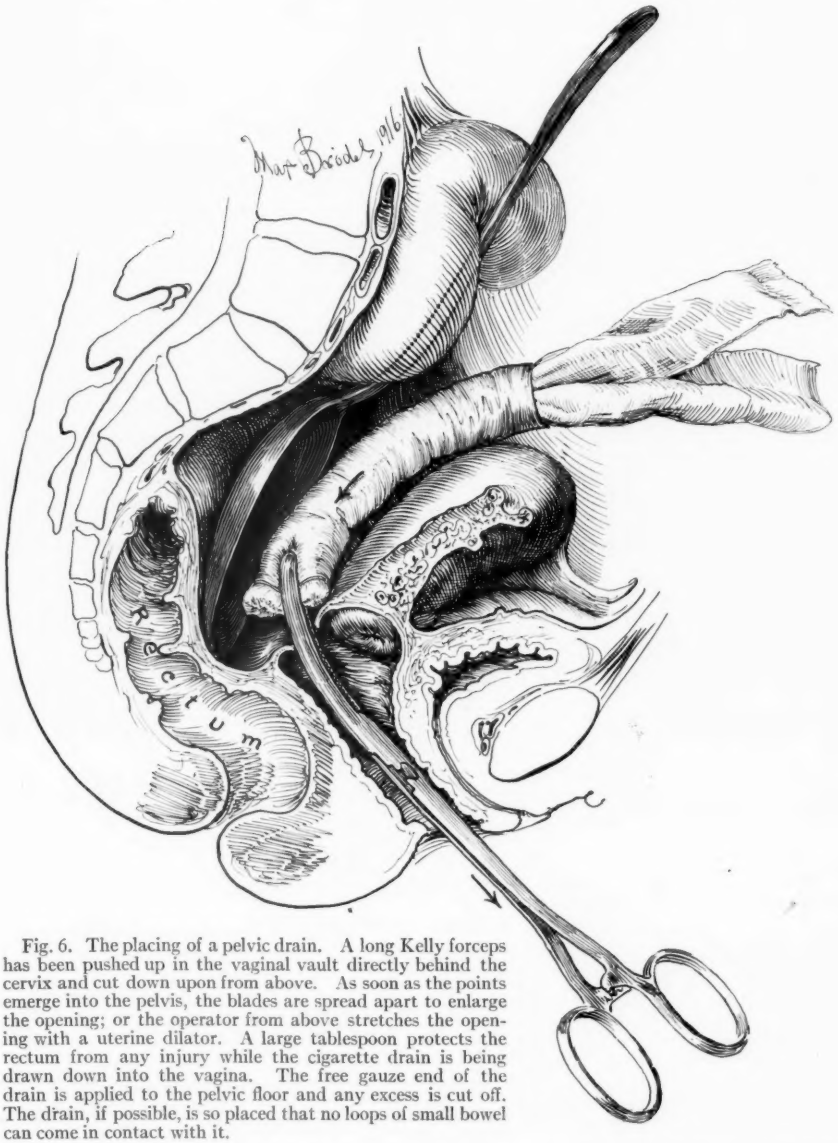

Fig. 6. The placing of a pelvic drain. A long Kelly forceps has been pushed up in the vaginal vault directly behind the cervix and cut down upon from above. As soon as the points emerge into the pelvis, the blades are spread apart to enlarge the opening; or the operator from above stretches the opening with a uterine dilator. A large tablespoon protects the rectum from any injury while the cigarette drain is being drawn down into the vagina. The free gauze end of the drain is applied to the pelvic floor and any excess is cut off. The drain, if possible, is so placed that no loops of small bowel can come in contact with it.

vis. A blunt instrument, on the other hand, will usually push well organized structures in front of it or to the side and out of harm's way. After the abscess has been reached the vaginal opening is well stretched with a uterine dilator.

When the abscess has been well evacuated, a finger introduced into the pelvis will enable the operator to determine with some degree of accuracy whether other abscess pockets exist. Sometimes, if a large pus tube is found, he either loosens it up with his finger

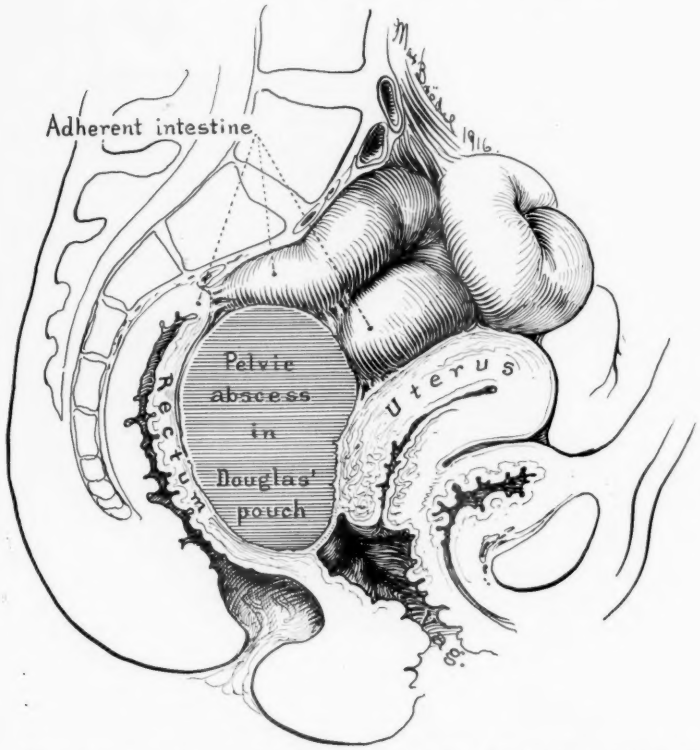

Fig. 7. A pelvic abscess. This abscess filled the pelvis and bulged slightly into the vagina. Frequently such an abscess encroaches markedly on the rectum. The distance between the abscess and the vagina is not over 2 or 3 millimeters.

or gently opens it with the end of the uterine dilator. With the escape of a large quantity of purulent material, when the pelvic abscess is opened, the surgeon naturally has an inclination to irrigate the pelvic cavity and wash away the fetid discharge. This should never be done. The greater part of the pus can be removed with gauze sponges. In 1896 I had a patient with a large pelvic abscess. Irrigation seemed to me to be imperative, and I irrigated with a boric acid solution. She promptly developed a general peritonitis and died. When we come back again to our composite picture of the pelvic condition present in such a case, we find that the roof of our abscesses is made up of omentum, and intestinal loops more or less adherent to one another (Fig. 8). Any undue pressure from below, such as would be caused by the pelvic irrigation, may readily cause the roof to give way. The irrigating fluid mixed with the pus from the pelvic abscess will then be forced up into the general peritoneal cavity and a general peritonitis will almost surely follow. Within the last month I have seen a case in consultation in which a few days after vaginal drainage of a pelvic abscess the cavity had been irrigated. The patient promptly developed a peritonitis which extended above the umbilicus. Fortunately, she is recovering.

After as many pockets as can be found have been drained iodoform drains are introduced. In removing the drains the operator must naturally be guided by circumstances. If there be signs of any damming back of the discharge, one drain may be removed at

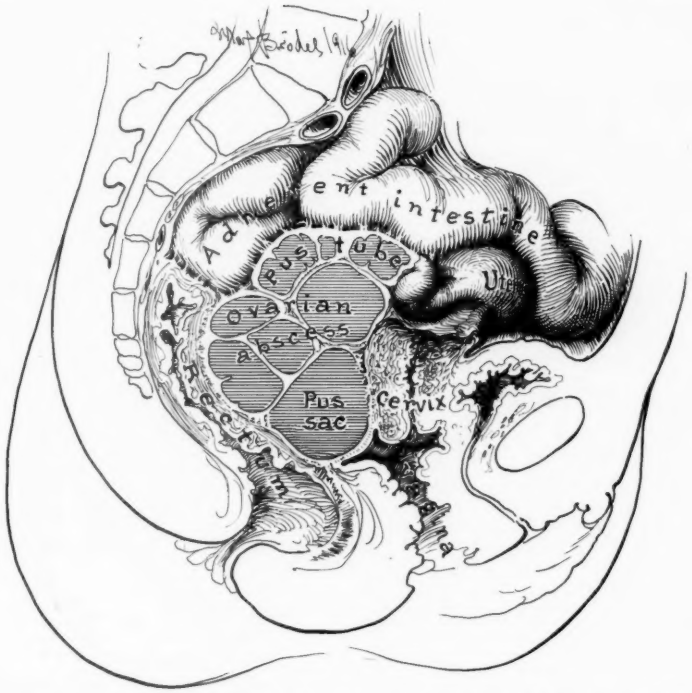

Fig. 8. A composite picture showing a general purulent pelvic condition. The tube on the right is filled with pus. The ovary contains several abscesses, and between the enlarged ovary and the pelvic floor is a purulent accumulation. A similar infection would probably be noted in the left tube and ovary.

Anteriorly the purulent mass is adherent to the uterus, posteriorly to the rectum, and partly forming the roof are adherent loops of bowel. The omentum is also often glued to the pelvic mass.

the end of twenty-four hours. The drains are usually started at the end of the second or third day, about two inches of each being removed at a time, our object being to have the abscess sac not only drain but gradually contract down on the gauze. After all the drains have been removed, it may still be necessary to stretch the vaginal opening a little and to introduce another small drain.

In all such cases as these, the relatives of the patient should at the outset be given to understand very clearly that a subsequent pelvic or abdominal operation, or both, may be necessary. When draining the pelvis you may have opened every abscess that could be felt and have done your work most thoroughly. In the following days, however, other small foci, which at the time of the original operation were not over 2 or 3 millimeters in diameter, have gone on developing until they now form a well-defined tumor mass. These may spontaneously rupture, but frequently they require to be opened.

In cases of pelvic abscess in which the patient is in a good physical condition and no complications exist I usually use the Fowler position at once and often allow the woman to sit in a chair on the following day. These patients improve much more rapidly and the upright position gives ideal drainage.

Where the pelvic infection is high up and when it cannot be well reached from below, the abdominal route seems preferable.

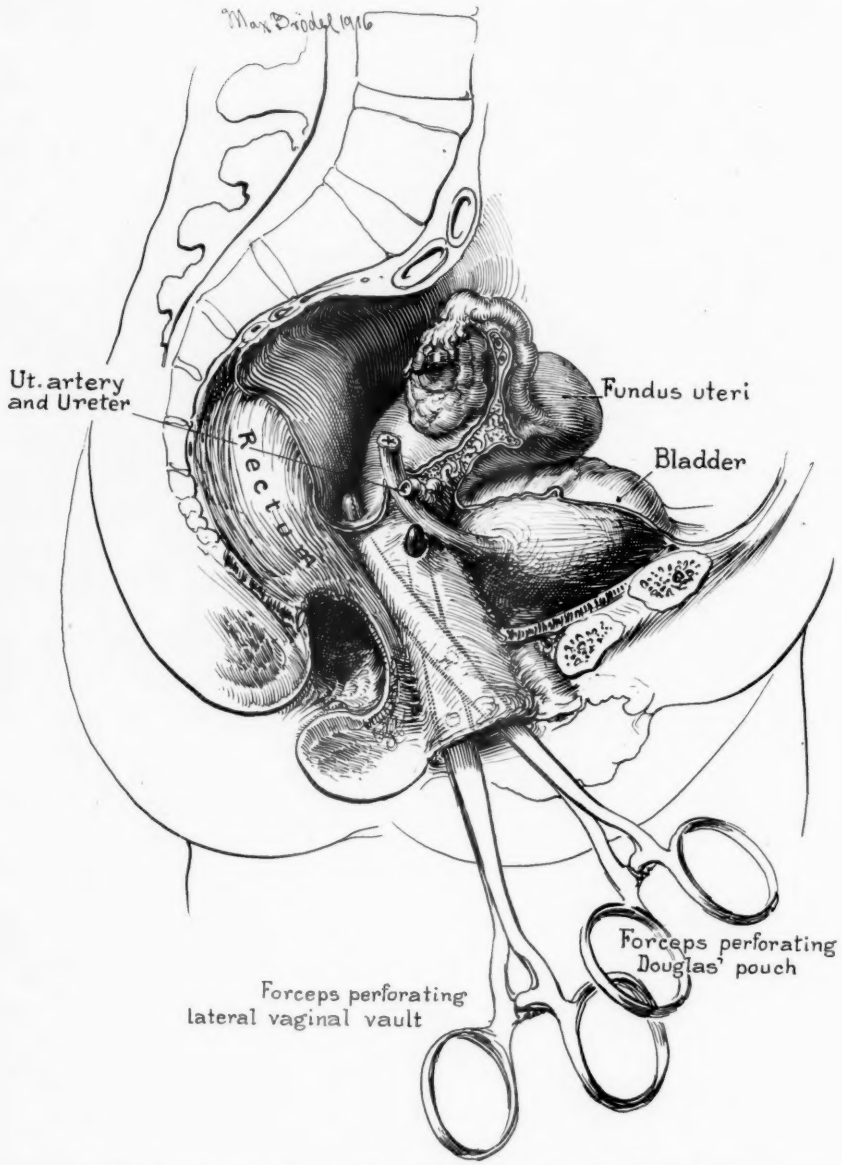

Fig. 9. The method of opening the broad ligament from the vagina. The forceps have been introduced into the vagina and carried to the posterior vaginal vault. In attempting to enter the broad ligament the septum between the vagina and Douglas' pouch is so thin that the forceps will frequently pierce the peritoneum and enter the pelvic cavity. If the operator is successful in entering the broad ligament without injuring the peritoneum, his forceps come in intimate contact with the uterine artery and ureter. The best way of reaching the broad ligament is from above, as indicated in Fig. 10.

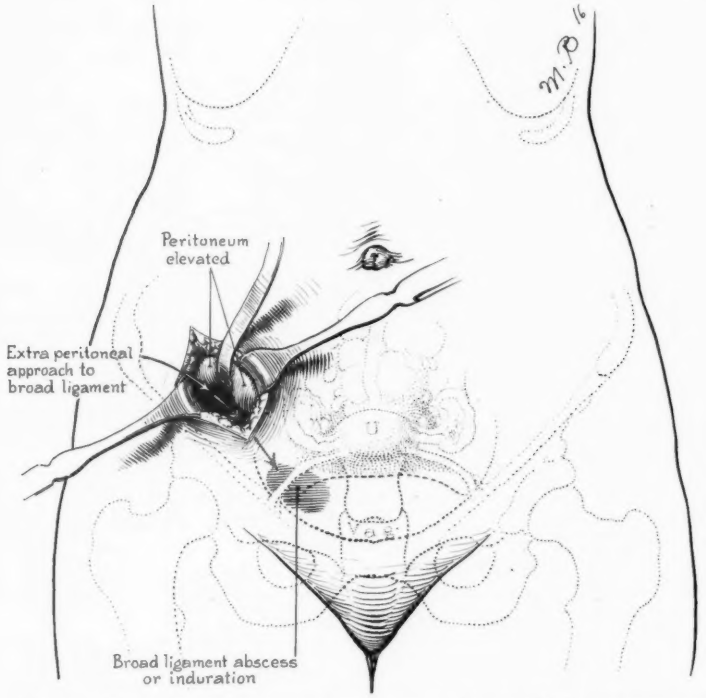

Fig. 10. The easiest and most satisfactory avenue of approaching a postpuerperal broad ligament abscess. A gridiron incision is made above and parallel with Poupart's ligament, and the fascia and muscles are split as in an appendix operation. As soon as the peritoneum is reached, it is pushed toward the median line but without being opened. The two index fingers then gradually spread the broad ligament until the area of induration is reached. A little pus or watery fluid will then usually escape. A drain is carried down to the indurated area and the abdominal incision is partially closed. If both broad ligaments are thickened, an incision is made on each side. Postpuerperal broad ligament indurations that have persisted for weeks will usually rapidly disappear after being drained in this manner.

THE TREATMENT OF POSTPUERPERAL PELVIC INFECTIONS

Many surgeons treat with trepidation the pelvic infections following puerperal sepsis. Let us for a moment compare the clinical histories of those who have had gonorrhœal infection with those who have had puerperal sepsis. The gonorrhœal patient, if married, may have become pregnant before the infection occurred. She has her one child and then, as a rule, no further conceptions. The woman who has had puerperal sepsis, on the other hand, frequently gives a history of a very serious illness of long duration following childbirth and then has several children in succession. What are we to infer from this? In the first place, the woman with the gonorrhœal infection has usually lost the use of her fallopian tubes, and in the second place the woman with the puerperal infection has still left fallopian tubes that are normal or so nearly normal that pregnancy can readily occur.

In most of the puerperal infections that come to the surgeon the focus seems to be in one or both broad ligaments. There is a small hard area of induration or œdema, but little or none of the induration or bulging in the pelvic floor so frequently noted in the non-pregnant pelvic infection. The organism

most frequently found in puerperal sepsis is the streptococcus.

Drainage is, of course, the wise procedure. How can this be best obtained? Where a general pelvic abscess exists one naturally wishes to drain the pelvis. Where the broad ligament is involved, pelvic drainage is not only contra-indicated but may be fraught with dire results. In many of the puerperal cases the vaginal vault is little, if at all, thickened, and if an incision is made behind the cervix and Douglas' pouch is opened up it may be found to be perfectly smooth. During the opening of the vaginal vault one naturally pierces the thinnest area of the broad ligament, and if the broad ligament is infected with streptococci, these germs will be carried into the general peritoneal cavity thus adding greatly to the risk. An unusually dexterous operator, after going through the vaginal mucosa just behind the cervix, may gradually worm his way with the blunt artery forceps up into the right or left broad ligament, but his instrument will naturally come into intimate contact with the ureter or uterine artery (Fig. 9), and if he happens to pierce the somewhat brittle peritoneum covering the indurated area his forceps will emerge into the pelvis. Postpuerperal broad ligament infections can be handled from above with the utmost ease and with the minimum risk of entering the abdominal cavity.

A gridiron incision is made above and parallel to Poupart's ligament, similar to that employed for a simple appendix operation (Fig. 10). As soon as the peritoneum is reached, it is gently pushed toward the median line. The two index fingers then gradually spread the folds of the broad ligament, just as in hunting for the vesical end of the ureter. As soon as the area of induration is reached, the operator stops. It is usually hard and œdematous. A little watery fluid or pus escapes. A drain is introduced and the operation is completed. If both broad ligaments are thickened, a similar procedure is employed on both sides. Indurated areas which have persisted for weeks and months will rapidly clear up. The operation takes only a few minutes and is entirely extraperitoneal.

SUMMARY

In the allotted time I have attempted to sketch briefly the salient points in the surgical treatment of pelvic infections. To some of you the entire subject is an old, old story, to others a few facts may have been new. The points that I particularly wish to leave with you are:

1. When an appendix abscess is opened the appendix can practically always be removed at the same time, provided the abscess is well walled-off with gauze before an attempt is made to open it.

2. In removing a large pus tube that is firmly adherent to the pelvic floor, it is better to begin by excising a wedge of the uterine cornu, and gradually freeing the mesosalpinx. The tube can then be lifted up as a straight rod and carefully walled-off on all sides before it is shelled off from the pelvic floor. Soiling is reduced to a minimum.

3. Pelvic drains that emerge from the vagina should, if possible, be so placed that they do not come in contact with the small bowel.

4. Vaginal drains laid in the pelvis during an abdominal operation should not be removed, as a rule, before the fourth or fifth day on account of the danger of pulling down an adherent loop of small bowel.

5. The vaginal drainage of a pelvic abscess may relieve the patient only temporarily. The development of other incipient abscesses may require several more vaginal operations before the inflammation subsides, and even then a subsequent abdominal operation may be necessary.

6. No case of pelvic abscess should be irrigated. There is danger of rupture of the abscess wall and of the escape of infectious fluid into the abdomen which will set up a general peritonitis.

7. Postpuerperal pelvic infections are found, as a rule, in one or both broad ligaments. Those in the broad ligament can be most satisfactorily opened extraperitoneally through a gridiron incision just above Poupart's ligament. Such accumulations should rarely, if ever, be opened through the vaginal vault.

THE TREATMENT OF CYSTOCELE AND UTERINE PROLAPSE[1]

By THOMAS J. WATKINS, M.D., F.A.C.S., Chicago

THE few minutes I am privileged to use will be devoted to discussion of some of the more important features of the treatment of cystocele and uterine prolapse.

If we recognize and keep foremost in our thoughts the fact that prolapse of the uterus and cystocele of the urinary bladder are essentially hernias, the operative treatment becomes immensely simplified. Attention will be centered chiefly in a consideration of the cure of these "hernias" by operations which change the relative positions of the bladder and uterus — the so-called transposition or interposition operations. The details of this technique will be demonstrated by drawings.

The transposition operation is usually limited to the treatment of patients near or subsequent to the menopause. It is useful in exceptional cases during the reproductive period, when the prolapse is extensive and when pregnancy is impossible or inadvisable. This will usually necessitate excision of a portion of each fallopian tube to render the patient sterile.

During the reproductive period, satisfactory results can usually be obtained, as the hernias then are not generally extensive, by the advancement operation of Goffe or by vaginal fixation of the round ligaments.

The transposition operation is the ideal procedure for the cure of cystocele after the menopause. The hernial opening through which the bladder prolapses is thus entirely closed by interposition of the body of the uterus. It makes, when properly performed, recurrence of the cystocele impossible. Absolute cure of uterine prolapse, however, is less certain, as it is usually impracticable to close entirely the hernial opening through which the uterus prolapses.

The modified transposition operation. The transposition operation should be modified in cases with a very large uterus or greatly elongated broad ligaments. In these cases, part of the uterus is excised; in some instances only enough of the posterior wall of the uterus is left to give a firm support to the bladder. In case of suppuration this remains intact and insures a satisfactory final result. Excessively elongated broad ligaments can be repaired by detaching portions of them from the cervix and by suture of the cut ends together in front of the cervix.

RESULTS

Extensive reports of results of the interposition operation in this country and abroad have been very favorable. There has been a small percentage of slight recurrence of prolapse of the cervix, or of the fundus of the uterus. With increased experience in selection of cases and modification of technique, this should seldom occur. A secondary operation, when necessary, is usually simple and effective.

The bladder. Vesical symptoms frequently exist before, and often continue for a time after, these operations. Temporary bladder disturbances result from the recumbent position of the patient during convalescence, also from traumatism of the overstretched bladder wall.

My associate, Dr. Curtis, is studying the postoperative condition of the bladder, both bacteriologically and otherwise, and has found that incomplete emptying of the bladder is a common cause of so-called postoperative cystitis.

Considerable distention of the bladder can occur without flatness or other suprapubic evidence of distention. In a recent case, thirty ounces were drawn by catheter immediately after urination, in the absence of any physical evidence of distention.

We believe that retention of urine is more harmful than catheter contamination.

DESCRIPTION OF ILLUSTRATIONS

In Figure 1 the cervix is shown pulled downward and held by a volsellum forceps. A free transverse

[1]Read before the Clinical Congress of Surgeons of North America, Philadelphia, October 23-26, 1916.

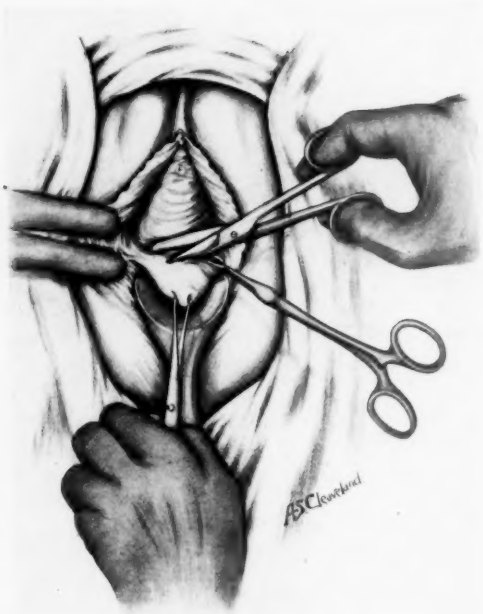

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

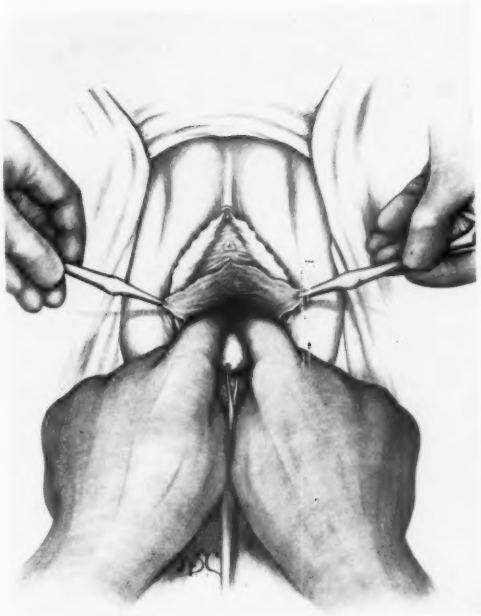

Fig. 5.

Fig. 6.

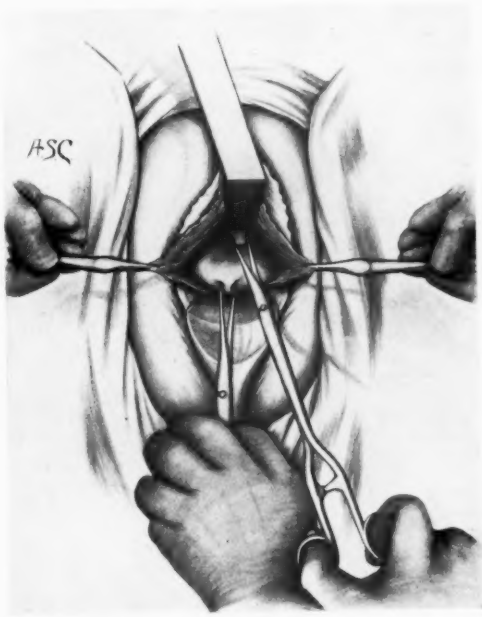

Fig. 7.

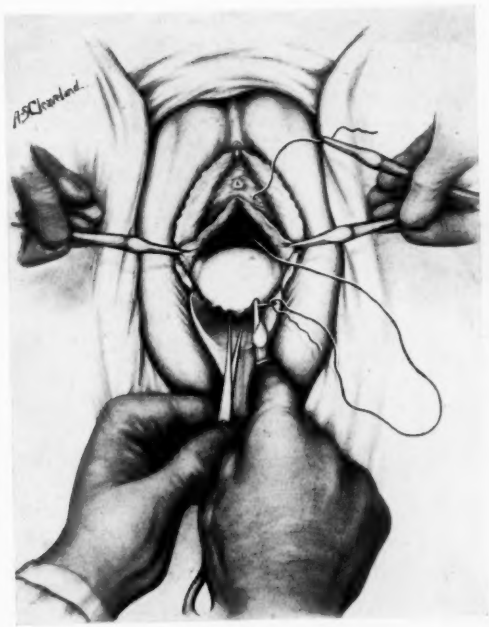

Fig. 8.

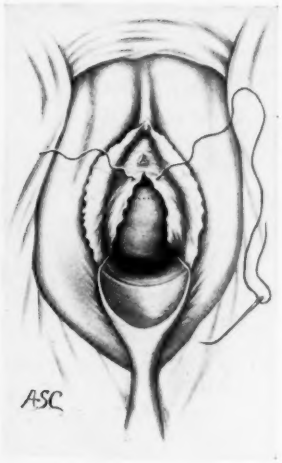

Fig. 9.

vaginal incision is made across the vagina in front of the cervix.

The vagina is separated from the bladder by blunt dissection with Mayo scissors as shown in Fig. 2. This is easily done if one finds the plane of fascia between the vagina and bladder. A short longitudinal incision will easily expose this fascia. The points of the scissors are kept close to the vaginal mucosa to avoid injuring the bladder.

The vaginal mucosa is incised along the median line the whole length of the prolapsed wall (Fig. 3). The plane of fascia between the bladder and cervix

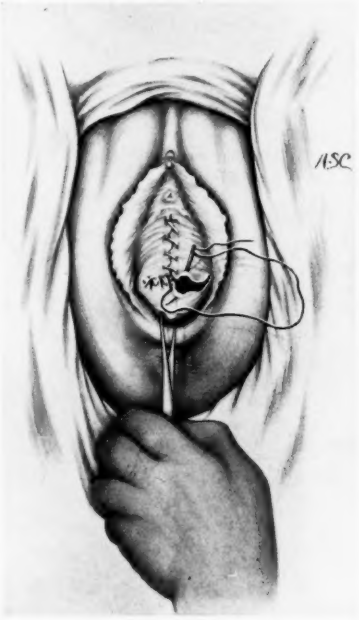

Fig. 10.

Fig. 11.

Fig. 12.

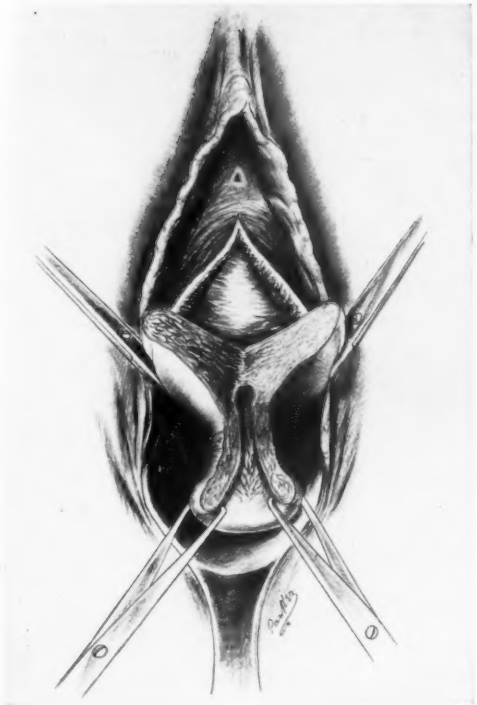

Fig. 13.

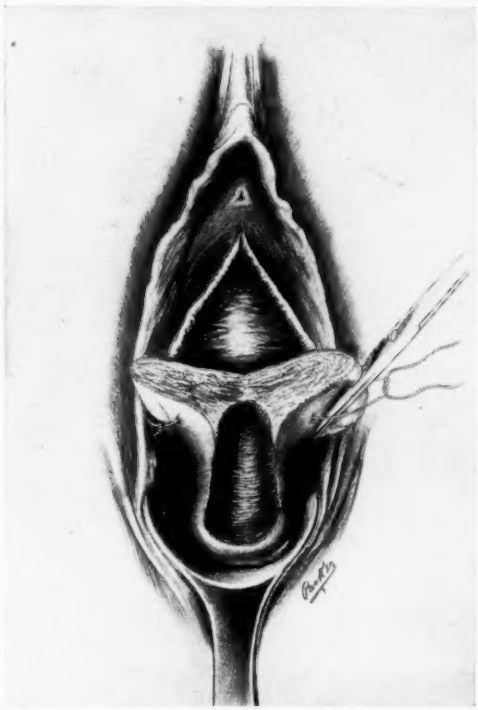

Fig. 14.

is exposed, and blunt dissection between the bladder and cervix is here illustrated.

The bladder is further dissected as freely as necessary from the vagina and cervix by the aid of gauze (Fig. 4). It is now advisable to ligate all bleeding points, as they are not easily exposed after the body of the uterus is delivered. The control of all bleeding lessens very much the danger of febrile disturbance after the operation.

It is often advisable to excise the anterior lip of the cervix in order to lengthen the anterior vaginal wall and force the cervix upward and backward. The cervix should be amputated when much hypertrophied and elongated.

In Figure 5 the bladder wall has been elevated by a ribbon retractor, the peritoneum between the bladder and uterus exposed and incised. The opening is stretched sufficiently to permit easy delivery of the body of the uterus.

Figure 6 shows a bullet forceps under the guidance of the finger, or by exposure with a retractor, grasping the anterior wall of the uterus.

The anterior wall of the uterus is successively grasped higher and higher (Fig. 7) until the fundus is reached, when the uterus is readily delivered into the vaginal canal.

Figure 8 shows the transposition of the bladder and uterus. The uterus is sutured to the vaginal mucosa and fascia underneath the bladder. The peritoneum is not sutured, as the peritoneal surfaces approximate without suture. In some cases it is advisable to suture part of the wound over the urethra before the suture is carried through the uterine wall. After the first uterine suture is placed and before it is tied, the body of the uterus is pushed into the abdominal cavity to guard against strangulation of the uterus.

In Figure 9 the redundant vaginal tissue has been excised. Each suture should include the fascia under the mucosa and pass through the uterus or cervix, and should be so placed when tied that the body of the urethra will be drawn upward in the line of the cervix to its normal location and fixed, and thus restore urinary control.

In Figure 10 the suture of the anterior vaginal wall is nearly completed. A deep suture to either side of the cervix will include the vaginal branches of the uterine vessels and control any bleeding that may be present. Most of the wound is closed with a longitudinal suture so as to lengthen the anterior vaginal wall.

Figure 11. The illustration shows the relative

position of the organs with the completed vesico-uterine transposition operation.

Figure 12 shows excision of a portion of fallopian tube.

Figure 13 illustrates the excision of a portion of the body of the uterus. This is advisable when the uterus is very large, and especially with a large uterus completely prolapsed. This is done by incising the anterior wall of the uterus in the median line through its entire length, as it is delivered into the vaginal canal. As much of the uterine wall is then excised as seems desirable.

All of the mucosa of the uterus may be excised as shown in Fig. 14. In very extensive cases, especially if the cervix is amputated, all of the mucosa is excised so that atresia of the cervix need not be feared. In this instance, only enough of the posterior wall of the cervix and uterus is left for a floor for the bladder.

When this is done, the round ligament and the bases of the broad ligament can be included in the sutures, so as materially to shorten them.

With this operation the wounded surfaces of the uterus should be thoroughly saturated with half strength tincture of iodine, as thrombi form in the uterine sinuses and contamination with the vaginal bacteria is very liable to result. It is also advisable to use some interrupted sutures in front of the cervix.

In the very extensive cases of complete prolapse in old women, where there is no objection to obliteration of the vaginal canal, the entire mucosa of the uterus and vagina may be excised and the hernial opening through which the uterus protruded completely closed.

The operation is completed by thorough repair of the posterior vaginal wall.

HÆMOLYTIC JAUNDICE: A REVIEW OF SEVENTEEN CASES

By H. Z. GIFFIN, M.D., Rochester, Minnesota
From the Mayo Clinic

FROM June 30, 1911, to September 13, 1916, seventeen patients with hæmolytic jaundice were under observation. The disease is of comparatively rare occurrence and may be easily mistaken for other conditions. Twelve of the patients were splenectomized; five were medical. Ten were men and seven were women, and their occupations were exceedingly varied. The youngest patients were 9, 13, and 19 years of age, respectively, and the oldest 49 years. Between the ages of 20 and 30, there were eight patients and between 30 and 40 there were five, the largest number presenting themselves between the ages of 20 and 30 years. Leukæmia, pernicious anæmia, and hæmophilia were noticeably absent in the family histories, and the patients had no knowledge of relatives with splenomegaly.

Jaundice. Seven of the seventeen patients had been jaundiced from infancy. Four others had been jaundiced since childhood, and four had an onset between the ages of 18 and 22 years. It is quite probable that in at least ten of the entire series the disease should be classified as congenital in type. There is also evidence that in some of the patients who had had an onset between the ages of 18 and 22 years the condition should be regarded as congenital. In clinical characteristics and severity, the symptoms corresponded to the congenital type. Moreover, an increased fragility of the erythrocytes in close relatives of patients of this age was demonstrated in two instances. Three cases were definitely familial; six others gave very suggestive histories of familial jaundice. One patient had a history of the onset of jaundice at the age of 32, and another as late as 46 years of age. These were severe cases of the acquired type. The jaundice in all the cases of this series was acholuric and seems never to have completely disappeared. It was remittent rather than intermittent. A tinge of yellow was said to remain after crises and to be present at all times. Several of our patients have stated that their jaundice was increased by excitement and nervousness. In all the twelve operative cases the jaundice was marked. In one patient with complications a trace of bile was at times present in the urine. Undoubtedly very mild cases occur in which the jaundice may be easily overlooked. The jaundice may also

be of very mild grade early in the history of a given case. Pruritus was noted in only one patient in spite of the frequent complication of cholelithiasis.

Splenomegaly. In twelve of the seventeen patients the spleen had been palpated previous to our examination. In one patient it had been easily palpable since infancy, and in another since the age of 7 years. Others had been recognized as long as ten and fifteen years previous to the examination. All were easily palpable at the time of examination. Mild cases of hæmolytic jaundice occur without an appreciable enlargement of the spleen. I have observed two patients with histories very suggestive of a mild grade of the disease, and spleens merely palpable, in whom there was an increased fragility of the erythrocytes in the peripheral circulation. On the other hand, the spleen in definite cases may be very large though it is never enormous as the spleen of leukæmia or splenic anæmia. In our twelve operative cases, it varied from 300 grams to 1780 grams, giving an average of 1070 grams, five or six times the normal size. In all of the non-operative cases the spleen was appreciably enlarged.

Enlargement of the liver. Two of the five non-operative cases presented evidence of enlargement of the liver. In one of these it was marked. Eight of the twelve operative cases showed enlargement of the liver at operation, and in two of these a surgical diagnosis of cirrhosis of the liver was made. The cirrhoses were of the granular rather than the lobulated type and of slight degree. The livers were not contracted. One patient only — an operative case — showed evidence of abdominal fluid; the amount of fluid was small. The liver was much congested but a positive diagnosis of cirrhosis could not be made. Two patients with a severe acquired type of the disease presented upon exploration very large livers. Two patients with a congenital type of the disease and very large spleens, 1250 grams and 1780 grams respectively, had livers which were apparently normal.

Crises. Sixteen of the seventeen patients gave a history of attacks, some very mild in character, of abdominal distress, nausea, fever, vomiting, and headache, and when gall-stones were present of seizures of severe pain. Usually these crises were mild during childhood and more severe in later life. In cases of short duration they were milder than in cases of long duration. The patient who gave a history of no crises did, however, complain of attacks of extreme weakness. The most important evidence that can be obtained from the history in arriving at a differential diagnosis of hæmolytic jaundice is recurrences of deepening jaundice with crises.

The blood picture. In these patients a history of severe recurrent anæmia was not obtained. In two instances only was the anæmia severe. In a majority of the cases it was of moderate degree and chronic type. The hæmoglobin in the twelve cases varied from 24 per cent to 86 per cent, and averaged 59 per cent. In the entire group of seventeen cases the lowest erythrocyte count was 1,340,000. In two patients the counts were between one and two millions, in one between two and three millions and in seven between three and four millions. The color index was, as a rule, high. In two instances it was more than 1.0; in five it was 0.9+, and in nine it was 0.8+. The uniformly high color index is quite definitely indicative of the myelotoxic factor in the disease. Normoblasts were present in three patients and megaloblasts in one. Nine patients showed slight or moderate deformity and degeneration of the erythrocytes. Leucocyte counts revealed an absence of leucopænia and a tendency to slight leucocytosis. The leucocyte count just prior to operation varied from 6,400 to 19,400 and averaged 10,950. Differential counts were not distinctly abnormal; there was an absence of lymphocytosis. After splenectomy there was, as a rule, a very prompt increase in the hæmoglobin estimation and the red-cell count. Postoperative leucocytosis was noted but it was not a constant finding. In a majority of the cases after splenectomy, there was an increase in the relative percentage of small lymphocytes and a decrease in polymorphonuclears. The reverse has been noted in our cases of pernicious anæmia after splenectomy; that is, the blood has shown an increase of polymorphonuclears.

TABLE I.—BLOOD COUNTS IN TWELVE CASES OF HÆMOLYTIC JAUNDICE: SPLENECTOMY

Case	Time Before and After Splenectomy	Hæmoglobin Per Cent	Red Blood Cells Millions.	Color Index	Normoblasts*	Megaloblasts*	Miscellaneous Findings	White Blood Cells	Polymorphonuclears Per Cent	Small Lymphocytes Per Cent	Large Lymphocytes Per Cent	Eosinophils Per Cent	Basophils Per Cent	Myelocytes Per Cent
1 (28194)	2 days before	65	3.29	.9+	3	0	0	10000	72.3	23.0	3.7	.7	0	.3
	20 days after	85	4.80	.8+	0	0	0	9200	76.0	15.0	4.5	3.0	1.5	.0
	3 months after	89	4.52	.9+	0	0	0	15400	55.5	35.0	8.5	.5	.5	.0
2 (86218)	9 days before	58	3.09	.9+	0	0		7400	79.7	16.3	.3	2.7	1.0	.0
3 (112836)	8 days before	40	1.74	1.1	26	0		9500	74.7	15.3	2.3	6.0	1.3	.3
	29 days after	35	1.80	.9+	203	1	Anisocytosis	26400	77.3	15.7	4.3	1.0	1.0	.7
	14 months. 20 days after	80	3.77	1.+	0	0	0	8000	58.0	31.0	9.0	2.0	.0	.0
	20 months. 14 days after	36	2.12	.8+	143	3	Anisocytosis, poikilocytosis	22600	68.0	21.7	6.3	2.3	1.3	.3
4 (135948)	7 days before	79	4.32	.9+	0	0	Anisocytosis, polychromatophilia	19400	78.0	15.0	4.0	3.0	.0	.0
5 (141268)	9 days before	24	1.34	.8+	57	0	Anisocytosis, poikilocytosis, granular degeration, polychromatophilia	15200	59.0	29.0	4.0	2.3	2.7	3.0
	18 days after	38	2.16	.8+	0	0	Anisocytosis, polychromatophilia	12600	64.7	16.3	10.7	6.7	1.7	.0
6 (142074)	1 month before	50	3.60	.7	0	0	Anisocytosis, polychromatophilia	10800	78.3	19.3	2.0	.3	.0	.0
	16 days after	69	4.28	.8+	0	0	0	6900	56.7	35.0	3.3	4.3	.7	.0
7 (148510)	7 days before	58	3.28	.8+	0	0		7700	65.3	28.7	5.3	.0	.7	.0
8 (153245)	6 days before	47	2.84	.8+	0	0	Anisocytosis, poikilocytosis	9800	76.7	14.7	6.0	2.3	.3	.0
	29 days after	60	4.88	.6+	0	0	Anisocytosis	11600	50.7	30.3	4.3	13.0	1.7	.0
9 (148209)	13 days before	80	5.00	.8+	0	0	0	7300	57.7	33.0	8.7	.7	.0	.0
	4 days after	82	5.12	.8+	0	0	0	13400	67.7	21.3	8.7	2.0	.3	.0
10 (161538)	7 days before	64	3.86	.8+	0	0	Anisocytosis, poikilocytosis, polychromatophilia	6400	75.7	20.3	3.3	.3	.3	.0
	21 days after	70	4.68	.7+	0	0	0	8100	55.0	37.7	4.3	1.3	1.7	.0
11 (162670)	9 days before	67	3.65	.9+	0	0	Anisocytosis, poikilocytosis, polychromatophilia	12200	62.3	32.0	1.7	4.0	.0	.0
	20 days after	80	4.22	.9+	0	0	0	12400	53.7	37.0	7.3	2.0	.0	Few
12 (94675)	8 days before	69	3.34	1.0+	0	0	Anisocytosis, poikilocytosis, polychromatophilia	9800	73.3	23.3	2.3	.7	.3	.0
	33 days after	73	4.76	.7+	0	0	Anisocytosis, poikilocytosis	16800	80.0	13.7	4.7	1.3	.3	.0
BLOOD COUNTS IN FIVE CASES OF HÆMOLYTIC JAUNDICE: NON-OPERATIVE														
13 (91298)		90	4.76	.9	0	0	0	3700	67.0	30.7	.7	1.3	.3	.0
14 (153653)		60	3.90	.8+	0	0	Anisocytosis, poikilocytosis	5800	45.0	38.7	14.3	.7	1.3	.0
15 (157525)		80	4.92	.8–	0	0	0	6000	69.0	19.0	9.0	1.0	2.0	.0
16 (169405)		81	4.88	.8+	0	0	0							
17 (172287)		83	5.06	.8+	0	0	0	8200						

NOTE.— Differentials are based on a count of 300 cells.
*Number of cells seen while counting 300 leucocytes.

The condition of the blood was reported as normal in nine of ten living patients from two months to five and one-half years after operation. However, in only a few of these patients has it been possible to obtain complete blood counts. In the tenth patient the hæmoglobin reached 80 per cent and the erythrocytes 3,770,000, fourteen months after

TABLE II.—FRAGILITY TESTS IN HÆMOLYTIC JAUNDICE

Non-Operative and Pre-Operative Cases

Case No.	Percentage of Sodium Chlorid in Which Hæmolysis was Complete	
	Patient	Control
2 (80218)	0.467	0.425
4 (135948)	0.4	0.34
5 (141268)	0.4	0.34
6 (142074)	0.42	0.38
8 (153245)	0.469	0.389
9 (148209)	0.4	0.36
10 (161538)	0.44	0.38
11 (162670)	0.4	0.36
12 (94675)	0.44	0.38
13 (91298)	0.4	0.316
14 (153053)	0.42	0.36
15 (157525)	0.42	0.36
16 (169405)	0.42	0.38
17 (172287)	0.42	0.36

TABLE III.—FRAGILITY TESTS IN HÆMOLYTIC JAUNDICE AFTER SPLENECTOMY

Case No.	Percentage of Sodium Chlorid in Which Hæmolysis was Complete.		Time After Operation
	Patient	Control	
3 (112836)	0.4	0.34	1 year, 8 months.
	0.48	0.36	1 year, 9 months.
5 (141268)	0.46	0.36	18 days.
6 (142074)	0.42	0.38	15 days.
8 (153245)	0.429	0.349	1 month
9 (148209)	0.36	0.36	23 days
	0.40	0.36	4 months.
10 (161538)	0.40	0.34	21 days.
11 (162670)	0.42	0.32	22 days.
	0.4	0.36	2 months.
12 (94675)	0.32	0.32	1 month.

operation, but a relapse occurred two years after operation, at which time the hæmoglobin was 36 per cent, and the erythrocytes 2,120,000. Improvement followed this relapse, and the blood is much improved two and one-half years after operation (see Table I).

The Ribierre or fragility test. The fragility of the red cells in the peripheral circulation to hypotonic salt solution was tested before splenectomy in all but three patients, and in two of these three the clinical characteristics were so clear that there can be practically no doubt of the existence of hæmolytic jaundice. The third patient showed an increased fragility when first tested twenty months after operation. In the fifteen patients tested, hæmolysis was complete at from 0.4 per cent to 0.48 per cent sodium chlorid with the controls usually at from 0.32 to 0.36 per cent. Results in the individual cases will be seen in Table II.

There was no decided or constant decrease of fragility in the cases after splenectomy. Eight patients were tested at periods varying from fifteen days to one year and nine months following operation. Only two of these showed a normal resistance; in one it was merely temporary. In none was there an increase of resistance. Table III shows representative readings.

The finding of an increased fragility of the red cells in members of the patient's family is significant. In one instance the patient's brother who also had had very mild attacks of jaundice showed a definite increase of fragility. In another instance the patient's mother, who never had had symptoms which were in the least suggestive of hæmolytic jaundice, showed complete hæmolysis in 0.4 per cent sodium chlorid. The age of both of these patients at the onset of symptoms was 18 years, suggesting that there is probably a congenital factor in some of the patients who have not had symptoms during childhood. Therefore, testing members of families, though there is no familial history of jaundice, becomes of the utmost importance.

Urine. Urobilin and urobilinogen were both present in the five cases in which the urine was tested for these substances. Bile was absent in all cases save one, in spite of the frequency of cholelithiasis as a complication. The diagnosis of hæmolytic jaundice may be at times confused by the presence of bile in the urine when an obstructive jaundice has been superimposed upon an acholuric jaundice.

Hæmorrhage. Hæmatemesis and melena occurred in one instance. Epistaxis occurred in four of the seventeen patients, but was never severe. The coagulation time (Bogg's coagulometer) was not increased in these patients with hæmorrhage.

Wassermann tests. The Wassermann tests were negative in eleven of thirteen patients tested. One patient (Case 15) was said to have had positive Wassermann tests twelve months and five months previous to examination, and a Wassermann test was positive at the time of examination. There was also a history of probable infection. This case was non-operative. One brother of the

patient had a history suggestive of hæmolytic jaundice. In another patient (Case 6) two Wassermann tests were positive before operation and one was negative after operation. A very careful search of the history and findings failed to reveal any evidence of infection. There was no evidence of syphilis in the spleen removed at operation. It is conceivable that syphilis might produce a condition simulating hæmolytic jaundice, though I have been unable to find record of cases in which the characteristics were identical. Case 15, however, may be an example of this occurrence.

Blood pressure. A noticeably low blood pressure was present in all of the cases except one, the systolic frequently reading below 115. The diastolic blood pressures were consistently low, averaging 72 in sixteen cases. This hypotension occurred irrespective of the degree or absence of anæmia.

Loss of weight. In general, very little loss of weight was noted. One patient, with a severe form of the acquired type of the disease, however, had lost 48 pounds.

Gall-bladder disease. Three of the twelve splenectomized patients in this series had been operated on formerly for gall-bladder disease, probably with the expectation of curing the condition. The incidence of gall-stones in the severe types of hæmolytic jaundice is high, however. Seven of our twelve operative cases (58 per cent) showed gall-stones for which a later operation was usually done. Removal of the gall-stones in a case of hæmolytic jaundice does not cure the condition, but, on the other hand, a patient after splenectomy may improve remarkably although retaining his gall-stones. The formation of gall-stones is doubtless an important incident in the course of hæmolytic jaundice. The attacks of acholuric crisis become more severe over a period of years and pain is added to the early syndrome of deepening jaundice, abdominal distress, fever, malaise, and headache until the pain becomes the prominent symptom and the attacks are quite typical of cholelithiasis.

The values for hæmoglobin-derived pigments in the duodenal contents (Schneider test). The values for urobilin and urobilinogen in the duodenal contents is doubtless an index of the blood destruction present at a given time. There is probably a marked variation in these values according to fluctuations in the course of the disease. They are, however, quite constantly high. Twelve duodenal tests were done on six of these patients. The average in patients before splenectomy was 2050 units for urobilin and 1100 units for urobilinogen. It is probable that in a larger series the values would average higher, for there is clinical evidence of active blood destruction. In two patients with very high values the blood picture simulated that of pernicious anæmia, a greater degree of blood destruction evidently exhausting the bone marrow. The same four patients, tested after operation at periods varying from thirteen days to four months, showed an average of 800 units for urobilin and 625 units for urobilinogen. It will be noted that there is a very considerable decrease in the values after splenectomy and that the decrease of urobilin is proportionately more marked than that of urobilinogen. The decrease is not as marked in the early period following splenectomy for hæmolytic jaundice as it is following splenectomy for pernicious anæmia. The fall in urobilinogen is less marked than in those cases of pernicious anæmia in which there is no definite evidence of change in the liver. Very soon after splenectomy for pernicious anæmia, urobilinogen falls to zero in 78 per cent of the cases. The values in one severe case of the acquired type of hæmolytic jaundice with a blood picture of pernicious anæmia, obtained only during a relapse one year and eight months after splenectomy, were high, showing a total of 4,000 units. These values were not included in the preceding averages. This patient had a large liver with probable biliary cirrhosis (see Table IV).

Transfusion. Preoperative transfusions were not necessary in any of the cases of this series. One patient who returned one year and eight months after splenectomy in a relapse of anæmia improved after two transfusions.

Postoperative course. The immediate improvement following splenectomy for hæmolytic jaundice is very striking. The jaundice

TABLE IV.—HÆMOLYTIC JAUNDICE

The Values for Hæmoglobin-Derived Pigments in the Duodenal Contents

Case No.	Time Before and After Splenectomy	Bilirubin	Urobilin	Urobilinogen	Total	Remarks
3 (112830)	1 year, 8½ months after.	+++	3000	1000	4000	Acquired. Estimation during relapse.
8 (153245)	1 day before 38 days after	+++ Trace	4600 1400	1000 1800	5600 3200	Congenital. Severe case.
9 (148209)	47 days before 14 days before 13 days after 140 days after	Trace Trace 0 0	1400 2000 800 Trace	1000 1200 1000 400	2400 3200 1800 400+	Familial. Mild case.
10 (161538)	3 days before 23 days after	— Trace	500 400	500 0	1000 400	Congenital.
11 (162670)	4 days before 21 days after	+++ ++	1400 1000	1800 200	3200 1200	Probably congenital.
14 (153653)	Non-operative	+	3000	Trace	3000+	Probably familial.

frequently becomes noticeably improved within twenty-four hours and may entirely disappear during the first few days. The condition of the blood likewise rapidly improves. Our first patient was operated on July 30, 1911, five and one-half years ago, and has been in excellent condition ever since that time. She had been constantly jaundiced from infancy to the time of splenectomy and has never been jaundiced since. During the five years preceding splenectomy she had had recurring attacks of anæmia but has not been anæmic since splenectomy. There was one operative death, a mortality of 8+% per cent. Reports from all save two of the other patients have been uniformly good. One boy of 9 years who had an extremely large spleen and an enlarged liver, together with a very severe grade of anæmia, has been in robust health since splenectomy. The condition of his blood improved with extreme rapidity after operation without any form of medical treatment other than hygienic care. Fifteen months after splenectomy the patient was in excellent health. The disease in the two patients who have not done so well was of the acquired type. One of them died four months after splenectomy. The other rapidly became very much improved and was in excellent health for one year and a half. She then had a relapse of both the anæmia and jaundice, but improved satisfactorily after two transfusions and is now in good health again. The remaining eight patients have been well for twenty-three months or less (Table V).

DISCUSSION

Hæmolytic jaundice may be regarded as the diagnostic keystone of the diseases associated with splenomegaly and anæmia. In clinical significance it occupies the center of a group of diseases with cirrhoses of the liver, syphilis of the liver with splenomegaly and obstructive forms of chronic jaundice, on the one hand, and pernicious anæmia, splenic anæmia, leukæmia and splenic Hodgkin's disease on the other. An appreciation of the characteristics of hæmolytic jaundice gives a new insight into the diagnosis of these interesting diseases. The differentiation between chronic jaundice due to obstruction of larger ducts and hæmolytic jaundice (which in part may be due to obstruction of smaller ducts) depends largely on a recognition of the type of jaundice present. The jaundice of uncomplicated hæmolytic jaundice is an intensified "hæmolytic" icterus, an exaggerated form of the icteroid tinge so constantly seen in pernicious anæmia. It is an acholuric jaundice; there is no bile in the urine. It is not associated with pruritus. It is of a chronic nature and may be comparatively deep or of mild grade. It is usually remittent in type and never entirely disappears. In obstructive jaundice there is cholic urine and frequently acholic stool; in hæmolytic jaundice, acholic urine and cholic stool. The second more important distinction between obstructive jaundice and hæmolytic jaundice lies in the difference in the resistance of the erythrocytes in the peripheral circula-

TABLE V.—HÆMOLYTIC JAUNDICE—SPLENECTOMY

CONDENSED TABULATION

Case	Sex and Age	Family History	Jaundice	Spleen	Accessory Spleens	Liver	Gall-stones	Fragility (Hæmolysis Complete)	Hæmoglobin Per Cent	Erythrocytes Millions	Date of Splenectomy	Result	Remarks
1 (28194)*	F 22	Not familial. Congenital	Since infancy. Acholuric	Chronic splenitis. 1530 grams.	1 large (removed)	Enlarged. Moderate cirrhosis.	+	Not tested	66	2.95	6-30-11	5½ years well. Good weight and color. No jaundice.	History clear for hæmolytic jaundice. Gall-stones removed 7 years previously.
2 (86218)	F 33	Acquired	2 years Acholuric	Chronic splenitis. 900 grams.		Enlarged. No duct obstruction.	0	.467	58	3.09	6-30-13	Death 4 months after operation. Terminal areas of superficial gangrene.	Jaundice never entirely disappeared.
3 (112836)	F 49	Acquired.	3 years. Choluric at times.	Chronic splenitis. 910 grams.	1 not removed	Greatly enlarged Smooth.	+	Post-operative .48	35	1.80	8-22-14	1½ years good health and color. 2 years after operation relapse. 2½ years general condition good.	Severe case with blood picture of a primary anæmia. Gall-stones removed at time of splenectomy.
4 (135948)	M 19	Not familial. Congenital.	Since infancy. Acholuric.	Chronic splenitis. 1050 grams.	2 small removed.	Enlarged. Not cirrhotic.	+	.4	79	4.32	7-23-15	23 months after operation. Excellent general condition. No jaundice.	Gall-stones not yet removed.
5 (141268)	M 9	Familial? Congenital.	Since birth. Acholuric	Chronic splenitis. 1370 grams.	2 (1 removed)	Enlarged.	0	.4	24	1.34	9-25-15	1 year 3 months after operation excellent health. No jaundice.	
6 (142074)	M 21	Not familial. Congenital.	Since childhood. Acholuric.	Chronic splenitis. 398 grams.		Normal.	0	.42	50	3.60	10-27-15	1 year 2 months after operation excellent health. No jaundice.	Cholecystostomy elsewhere 3 years previously. 2 positive Wassermanns before operation; 1 negative after. No history of lues.
7 (148510)	M 24	Not familial, Congenital.	Since infancy. Acholuric.	Chronic splenitis. 1000 grams.	1 removed.	Slightly enlarged.	0	Not tested	58	3.28	12-31-15	Death 1 day after operation.	
8 (153245)	F 38	Familial. Congenital.	Probably since infancy Acholuric.	Chronic splenitis. 1700 grams.		Greatly enlarged.	+	.469	47	2.84	3-4-16	9 months after operation hæmoglobin 90 per cent. General health satisfactory.	Gall-stones removed at secondary operation. Very severe case.
9 (148209)	M 20	Familial.	2 years. Acholuric.	Chronic splenitis. 300 grams.	1 removed.	Slightly enlarged and cirrhotic.	0	.4	80	5.00	5-4-16	7 months after operation color and general health excellent. Slight jaundice at times.	Cholecystectomy 3 months previously. Brother showed increased fragility.
10 (161538)	F 27	Congenital.	Since infancy Acholuric.	Chronic splenitis. 560 grams.		Probably normal.	+	.44	64	3.86	6-10-16	6 months after operation color and general health very good. No jaundice.	Cholelithotomy at time of splenectomy.
11 (162670)	M 31	Familial? Congenital?	21 years. Acholuric.	Chronic splenitis. 1250 grams.		Normal.	+	.4	67	3.65	6-23-16	5 months after operation color and general health very good. No jaundice.	Gall-stones not yet removed.
12 (94675)	F 30	Familial. Congenital?	23 years. Acholuric.	Chronic splenitis. 1780 grams.		Normal.	+	.44	69	3.34	9-21-16	2 months after operation excellent color and general condition. No jaundice.	Cholecystectomy at secondary operation.

HÆMOLYTIC JAUNDICE—NON-OPERATIVE

13 (91298)	M 23	Acquired?	2 years. Acholuric.	Moderately enlarged		Normal on examination.		.4	90	4.76		3½ years after examination general health good. Jaundice persists and recurs.
14 (153653)	M 23	Familial?	5 years. Acholuric.	Moderately enlarged.		Markedly enlarged.		.42	60	3.90		9 months after examination health good. Mild attack of jaundice.	Mother showed increased fragility but had no jaundice.
15 (157525)	M 24	Familial? Acquired?	2 years. Acholuric.	Moderately enlarged.		Normal on examination.		.42	80	4.92		1 year after examination. Has had one severe crisis with jaundice, 2 negative Wasserman tests.	History of lues. Wassermann positive. May be luetic splenomegaly. Brother had history suggestive of hæmolytic jaundice.
16 (160405)	M 31	Familial? Congenital.	Since childhood. Acholuric.	Slightly enlarged.		Slightly enlarged		.42	84	4.80		6 months after examination. Good health.	History of father and one sister suggestive of hæmolytic jaundice.
17 (172287)	M 13	Familial?	Since infancy. Acholuric	Palpable.		Normal on examination.		.42	83	5.06		3 months after examination general condition good. Color improved.	Mother's fragility increased. Mild, questionable case.

*Case 28194 was reported as one with the clinical syndrome of splenic anæmia in *American Journal of Medical Sciences*, 1913, cxlv, 781–795. Additional history obtained since that time was conclusive for a diagnosis of hæmolytic jaundice.

tion to hypotonic salt solution. In obstructive jaundice the resistance of the red cells is quite constantly increased — sometimes very markedly increased — while in hæmolytic jaundice it is decreased; that is, the cells are more fragile. This has been found to be a congenital condition, and members of the family should be tested for fragile corpuscles in order to ascertain exact data concerning the congenital factor in a larger percentage of the cases. An increase of fragility in other members of the family may prove to be corroborative evidence to a diagnosis.

Certain types of cirrhosis of the liver with jaundice may prove to be impossible of a clinical classification. While the spleen is usually smaller in cirrhosis of the liver than in hæmolytic jaundice, and the resistance of the red cells is increased, both of these criteria may be vitiated; that is, the spleen may be quite large and the presence of toxic substances and bile pigments may affect the resistance of the red cells. I have seen so confused a condition in the same patient as cirrhosis of the liver, marked splenomegaly, cholelithiasis and a pernicious anæmia type of blood picture, when only a definitely increased fragility of the red cells indicated the way to a diagnosis of hæmolytic jaundice as the probable primary condition. A more baffling confusion may exist when hæmolytic jaundice has progressed through its attacks of acholuric crises to typical attacks of cholelithiasis with a secondary obstructive jaundice superimposed upon the original hæmolytic jaundice. In this event, the Ribierre test for an increased fragility of the erythrocytes, if positive, becomes of especial importance. Increased fragility, a history of former recurrent attacks of jaundice and crises, together with a predominating splenomegaly and a more or less severe anæmia will usually, upon careful analysis, serve to indicate the proper diagnosis.

Syphilis of the spleen may simulate the clinical picture of any of the other forms of the splenomegalic syndrome. An enormous spleen, deep chronic jaundice, recurrent jaundice, cirrhosis of the liver, and probably even the pernicious anæmia type of blood picture, have each been observed as associated with

and probably a result of syphilis. I do not know of an instance, however, in which the exact syndrome of hæmolytic jaundice, complete in all its details, has been reproduced by syphilis.

The importance of obtaining a history of recurrent attacks of jaundice is exemplified in the mistake not uncommonly made of confusing hæmolytic jaundice with simple splenic anæmia. The history of every patient with suspected splenic anæmia should be reviewed carefully for former attacks of jaundice and crises of the acholuric type. In this way only will patients with little or no jaundice at the time of examination be differentiated. Hæmolytic jaundice is always to be considered before a diagnosis of splenic anæmia is made.

Pernicious anæmia may simulate hæmolytic jaundice. Given a young patient with a large spleen and evidence of very active hæmolysis resulting in a moderate degree of icterus, hæmolytic jaundice would at once be suspected. The pernicious-anæmia type of blood picture with high color index occasionally occurs in hæmolytic jaundice when myelotoxic features have developed, and this finding further confuses the picture. It would appear that the chief reliance in these cases must be placed upon the absence of a typical history of pernicious anæmia and the finding of fragile red cells; for in pernicious anæmia there is not the increased fragility which is found in hæmolytic jaundice. In many cases of pernicious anæmia in which the Ribierre test has been done, the resistance of the erythrocytes to hypotonic salt solution has been constantly normal or increased.

Splenic Hodgkin's disease usually remains undiagnosed until surgical exploration or autopsy. The spleen is nodular and this characteristic may be possible of recognition upon physical examination. A history of the former enlargement of the lymph nodes may be obtained while the lymph glands may be small and the spleen large at the time of examination. In every case of splenomegaly the condition of the lymphatic system demands observation, and if necessary, a gland should be excised for pathologic diagnosis. I have recently seen two patients with Hodgkin's disease who presented very large spleens and small lymphatic glands; in one of these a diagnosis was made upon the microscopic examination of an excised gland.

Leukæmia may be seen during a period when the spleen is only moderately enlarged, the anæmia is severe, a blood picture simulating the primary type of anæmia is present, and myelocytes are absent. With any considerable enlargement of the spleen in leukæmia, however, the blood picture is usually, though not always, pathognomonic. One patient came under my observation in whom a characteristic blood picture of leukæmia was not obtained until several years after splenectomy. The case had been formerly regarded as one of splenic anæmia. In a more recent case of leukæmia there was some resemblance to hæmolytic jaundice but the fragility of the erythrocytes was not increased.

A very valuable general discussion concerning the diseases associated with splenomegaly, anæmia, and jaundice has been published by Krumbhaar. The literature of splenectomy in the treatment of hæmolytic jaundice was summarized in 1915 by Elliott and Kanavel who were able to collect forty-eight cases. In the earliest case they found the patient was operated on by Sir Spencer Wells in 1887, and reported by Dawson twenty-seven years later as cured. The fragility of the erythrocytes in this case was still increased. A patient operated on by Bland Sutton in 1895 was well ten years later. Since the publication of the report by Elliott and Kanavel, Hellstroem has recorded two cases, Peck three, and Freidman and Katz one. Including the twelve cases here discussed, a total of sixty-six cases of splenectomy for hæmolytic jaundice has been reported. The surgical indications and technique of splenectomy have been elaborated by Mayo and Balfour.

SUMMARY

1. Seventeen cases of hæmolytic jaundice are reviewed, of which four are probably of the acquired type. In twelve of them splenectomy was performed.

2. An increased fragility of the erythrocytes in the peripheral circulation was a constant finding in all the fifteen patients

tested. This increased fragility was found to persist at varying periods after splenectomy in seven of eight patients tested.

3. The values for urobilin and urobilinogen in the duodenal contents were high in six patients in whom they were estimated. There was an appreciable fall in these values following splenectomy.

4. In seven (58 per cent) of twelve splenectomized patients gall-stones were present. The removal of gall-stones has not cured hæmolytic jaundice. On the other hand, patients with hæmolytic jaundice who were splenectomized have been cured of their jaundice and anæmia though retaining the gall-stones.

5. Of the twelve patients on whom splenectomy was performed, ten are living; nine are in excellent health without jaundice or anæmia. There was one operative death. One patient died four months after operation; another patient with a severe form of the acquired type of the disease was in excellent health for eighteen months, had a relapse after two years, and is again in fairly good health after two and one-half years following two transfusions. Four patients have been in excellent health for fourteen months, fifteen months, twenty-three months, and five and one-half years respectively.

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PERFORATIONS OF GASTRIC AND DUODENAL ULCERS[1]

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THAT ulcers of the stomach and duodenum frequently destroy all the coats does not seem strange when one considers the thin walls of these viscera. According to the best statistics obtainable 20 per cent of the duodenal ulcers sooner or later perforate, while perforation occurs in only about 7 per cent of the gastric ulcers. Why perforations should be three times as likely to occur in duodenal than in gastric ulcer is not clear. It does not seem reasonable that it is entirely due to the thinner wall. The apparently greater tendency for infiltration and thickening of the base of a gastric ulcer may give it greater immunity.

It is desired to limit the latitude of this paper to a consideration of so-called acute perforations. These are almost all fatal unless an early diagnosis is made and proper treatment carried out before the resulting peritonitis is too far advanced. It is fortunate that most of these perforations are in the anterior wall of the stomach and in the more accessible portions of the duodenum.

In so acute and serious a condition where prompt operation is all important, it is bad practice to load up with a multiplicity of diagnostic signs which are time-consuming, burdensome to a suffering patient, and not of very much consequence anyway. Among the diagnostic points, then, only those of capital importance and those that can easily be made use of at the bedside without waste of time will be considered.

The onset is always sudden, the course rapid and unless a timely operation is done, there is inevitably a fatal ending. Uppermost in one's mind should be kept the fact that this calamity must be met promptly, with the best proved methods, and that each hour's delay will be penalized by the loss of a definite percentage to the operative chances.

After learning of the sudden onset of pain, if carefully questioned, the patient will usually give a history of previous gastric symptoms and will often describe a feeling of increased discomfort and vague stitchlike pains in the upper abdomen lasting several hours or even days before the storm burst. These symptoms are probably due to the fact that the ulcer had penetrated to the peritoneal coat and produced a localized irritation or inflammation of the peritoneum at the site of the impending perforation. At this stage, when the benevolent omentum drops over the irritated spot and adheres, a so-called chronic perforation occurs and acute perforation is prevented. Or if instead of the omentum, a wide-awake surgeon should happen along, learn of the increase in intensity of the symptoms and rightly interpret them, advise an immediate operation, and have the advice accepted, he could forestall the perforation. Although such a contingency is not to be looked for every day, it is conceivable, and would avert a serious calamity.

The first symptom of perforation is sudden, acute, agonizing, unendurable pain. The patient lies absolutely still because every movement increases his pain. Every one I have questioned on this point has said that he had never before conceived that such extreme torture could be. He scarcely dares breathe for even ordinary respiration increases the pain. The tense motionless attitude is in marked contrast to the extreme restlessness of one suffering from severe colic, whether it be renal, intestinal or hepatic, for these conditions are marked by continual changes of position with the hope of getting relief. The torture from a perforating gastric or duodenal ulcer seems several degrees greater than that from a perforation of the gall-bladder or the appendix. This is probably accounted for by the acid gastric juice coming in contact with the peritoneum.

Almost immediately after the perforation the abdominal muscles become intensely rigid. The board-like rigidity is so great that one might stand on the abdomen and make no impression on the tensely contracted muscles. During the first few hours

[1] Read before the Western Surgical Association, St. Paul, December 18, 1916.

the rigidity, if it be possible, is even greater over the site of the perforation than over the other regions of the body, though this is comparing a superlative with another superlative. In the beginning, pressure over the seat of the lesion elicits more exquisiteness of tenderness than in other places.

The early pain of perforating gastric ulcer is much the same as that from perforation of the duodenum. After an hour or two, there are one or two points of distinct difference. The pain and tenderness following the perforation of an anterior gastric ulcer is more general over the abdomen especially in the central and left abdomen due to the more general soiling of the peritoneum by the pouring out of the gastric contents.

On the contrary, the fluid passing through a perforation of the duodenum is carried along the trough of the transverse colon toward the right, around the hepatic flexure, and down along the outer side of the ascending colon to the right iliac fossa. And thus it is often found in an hour or two after perforation of a duodenal ulcer, the greatest point of tenderness appears to be in the region of the appendix. For this reason a preoperative diagnosis of ruptured appendix is common. In two of my own cases this error was made. It is an awkward mistake and necessitates an additional incision or an unnecessarily long incision when the appendiceal wound is extended upward.

Greater care in eliciting the anamnesis and a patient effort to learn the exact location of the primary pain will often make it possible to avoid such an error. It is rare that perforation of the appendix occurs without some preliminary symptoms in the right iliac fossa.

After perforation of a gastric or duodenal ulcer, only a few hours will elapse before the symptoms become those of general peritonitis. Most of my cases had reached this stage before I had an opportunity to examine them. After the onset of peritonitis, the pain and tenderness are so general and the tenderness at the seat of perforation so nearly the same as that all over the abdomen that little knowledge of the primary lesion can be gained by examination at this time. If a correct diagnosis is made when the patient is not seen until the advent of general peritonitis it must depend on the location of the first pain, its intensity, and the history of the case before the perforation occurred.

If ideal conditions obtain the diagnosis will be made and operation done before the onset of general peritonitis. At this time the diagnosis is easier and more likely to be accurate, and the chances of successful operation are much better. Every hour that elapses after the perforation adds to the mortality. Unfortunately many of these cases are not operated upon until the peritonitis is well advanced. It would be better to be operated upon by a sensible surgeon of only limited experience within six hours after a perforation than by the best surgeon in the United States twenty-four hours later.

Whether it is possible to make a definite preoperative diagnosis or not, it is always apparent that a serious intra-abdominal calamity has occurred and the indications cry out loudly for an immediate operation. When this call is not heeded the attendant takes upon himself a burden of responsibility too heavy for any man to carry.

Careful but rapid preparations should be made, preferably in a hospital but in the patient's home if the hospital is too far away. The incision is made high up to the right of the median line or in the median line if the greatest tenderness is there. Gastric or duodenal leakage usually leads one at once to the seat of the perforation where gas and duodenal or gastric contents can be seen to be seeping out.

The point on which there is the greatest disagreement is how much or how little shall be done. Shall the perforation be sutured in the simplest manner possible and the operation end there? Shall the perforation and ulcer be so thoroughly turned in with superimposed sutures that it produces narrowing of the outlet of the stomach? Shall the ulcer be excised? Shall an omental graft be used? Shall gastro-enterostomy be done? Shall drainage be used in every case and how?

Hard and fast rules will never apply in lesions of this kind. For best results, the type of operation will have to conform to the pathology found. When the operation is

done early before peritonitis has developed the procedure will never be the same as in the cases of advanced peritonitis.

When the operation is early it can at least approximately conform to the method followed in an ordinary ulcer with stenosis such as the surgeon is so frequently called upon to perform. In such a case, the thorough turning in of the ulcer with sutures to the degree of as nearly as possible obliterating the outlet of the stomach is a reasonable procedure. To make assurance doubly sure I like to overlap the gastrohepatic omentum and the right border of the great omentum over the line of suture and hold them there with one or two stitches. If the perforation is very recent and the ulcer can be excised without too much additional risk, and the wound closed and covered as before, it is still better.

This latter procedure commends itself not only from a natural desire to get rid of the pathology and render improbable another perforation, but to minimize the chance of cancer developing in the border of an imperfectly healed ulcer. In either event the next logical step is to perform a posterior gastro-enterostomy, the opening in the stomach being made as near the pylorus as practicable.

If the perforation is on the anterior wall of the stomach away from the pylorus, excising of the ulcer or turning it in is all that is necessary. Gastro-enterostomy in such a case will serve no useful purpose. If the perforation is in the posterior wall of the stomach it can usually be sutured from behind, either working through a slit in the transverse mesocolon or sometimes through a slit in the lesser omentum.

Should the operation be done very early and the leakage found to have been very slight I can conceive that it might be proper to close the abdominal wound without drainage. Personally I have never done this because I have feared to do so. In the few cases operated upon early, there has always been enough leakage to make me fear the consequences of complete closure of the abdomen. In some cases the original wound has been closed and only drainage of the cul-de-sac made use of, keeping the patient in the Fowler position.

Even in cases with a very young peritonitis the method already described can safely be employed. The more advanced the peritonitis the more is a gastro-enterostomy to be feared. Inflamed and infected peritoneum is very prone not to heal kindly. The more advanced the peritonitis the less likely is it to heal promptly and perfectly. Furthermore when the peritonitis is far advanced and the vitality of the patient reduced his ability to withstand the more prolonged operation is greatly lessened.

It is my conviction that in late operations the less we do besides stopping the leak and establishing adequate drainage the better. Simple suture of the perforation in a direction to produce the least possible narrowing of the stomach outlet and covering the site of the perforation with an omental graft is quickly done. Even though a gastro-enterostomy has to be performed later it can be done much more safely after the peritonitis is relieved. I am very much in favor of doing the operation in two stages rather than subjecting the patient to unnecessary danger by doing the more complete operation when he is in such poor condition to stand it. Many of these cases will not require a subsequent gastro-enterostomy, if undue narrowing of the stomach outlet is avoided.

The manner of draining is of the utmost importance. Poorly placed and badly chosen drains have cost many lives. If the operation is fairly early, drainage at the site of perforation is not always necessary. A large rubber tube, not too hard, but not too easily collapsible, introduced through a stab wound above the pubes and accurately placed at the bottom of Douglas cul-de-sac by a guiding hand in the abdomen, and kept syphoned out is sometimes all the drainage required.

In the majority of cases greater safety seems to lie in additional drainage in the region of the perforation. A split rubber tube containing a roll of gauze or a cigarette drain, the size of the tube or cigarette drain depending on the amount of the pathology, seems to be much better than more massive drainage. Unless the perforation is exceed-

ingly minute and the leakage practically nil, I should not be satisfied without the tube in the cul-de-sac whether the primary wound is drained or not.

There seems to be more or less difference of opinion with reference to the best disposition to be made of the migrated gastric contents and the inflammatory products resulting from the peritonitis. I can only give my own method and the reasons for it. I never irrigate the peritoneal cavity under any circumstances. If the operation is early, before peritonitis has begun or before it has become general, irrigation is bound to carry gastric contents or infective material to portions of the peritoneal cavity not yet involved. It converts a local trouble into a general one.

When peritonitis starts, nature immediately begins its benign work by throwing out an exudate on the peritoneal surface of fibrin and leucocytes which with the serum form a film of protection which prevents rapid absorption of the toxins and micro-organisms and safeguards the body against an overwhelming toxæmia or infection. Irrigation, no matter how gently done, washes away this protecting film, opening the avenues of absorption. I have seen such acute toxæmia follow irrigation that a fatal issue resulted in a few hours.

I make no great effort to get rid of the peritoneal débris. Wiping it away is almost as bad as irrigation. If gross particles show themselves they may be gently picked away or dipped out with a large spoon or soup ladle. Sometimes a pool of foul material may be sopped up with a large gauze sponge wet in normal salt solution. The gauze should never rub or wipe.

After the operation, with drainage of the cul-de-sac, the Fowler position, and the Murphy method of using salt solution per rectum there will be a sufficient current of serum in the direction of the cul-de-sac to pretty thoroughly clear away the débris within a few hours. The peritoneum is able to so far disintegrate any gross particles that they are easily carried along by the current. It is so gently done that no violence is done the peritoneum as would have happened by irrigation or sponging in too great eagerness to secure an ideal peritoneal toilet.

PERITONEAL ADHESIONS[1]

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PERITONEAL adhesions are relics of past peritonitis, or are a result following mechanical or chemical trauma. They represent a conservative reaction on the part of the animal economy and all are essentially benign in their intent. Should the formation of peritoneal adhesions be inhibited, both abdominal surgery and recovery from intraperitoneal infection would be unheard of. The peritoneal adhesion has a mission to perform and only when its function is exaggerated or perverted does it become an undesirable factor. Therefore, the purpose of the research surgeon does not seem to point to their prevention, but rather to attain a better understanding of their natural history, and to suggest means of turning them to useful purposes.

The attempt to prevent the formation of adhesions by inhibiting fibrin formation with the use of citrate, phosphorus, or peptone, while it may for a time postpone scar-tissue formation, does not seem advisable for the following reasons: The use of citrate particularly makes the control of hæmorrhage difficult; and, according to Sweet, Chaney and Wilson, it tends to disseminate infection, and interferes with repair. In case of survival of the animal, it does not always prevent adhesions. The modification of the citrate method, as suggested by Pope, by using it on gauze packing, seems an unsatisfactory compromise. In many instances too much energy is wasted in attempts to cure adhesions by the knife. Therefore, this paper will discuss the causes of adhesions, the natural course of development of an adhesion, if it is possible to permit of its development, and finally what surgery can do to relieve the symptoms that come from adhesions by controlling the direction of their occurrence.

Before attempting these problems, one must know the character of adhesions. Under the term "adhesion" a great variety of pathology is included. In the broadest sense the term adhesion includes everything from peritoneal agglutination to the true adhesions made up of connective tissue with definitely organized blood-vessels. For practical purposes an adhesion is a definite organization of scar tissue between two or more structures. In addition, we may have scar tissue in the visceral peritoneum without adherence to any other structure. This may be demonstrated by gauze stripping of the intestine with almost the same results obtained by Wegner, who studied the changes in the endothelium of the peritoneum after trauma with air blast. These changes range from fatty degeneration of endothelium with subsequent desquamative change to ultimate connective-tissue replacement.

Hertzler has shown that limited destruction of endothelium resulted in agglutination, but when the trauma reached to the subendothelial connective tissue true scar tissue proliferation took place together with vascularization. Hertzler emphasized the important rôle of inhibition of peristalsis in the statement that "irritation of an intestinal wall with the point of a needle after primary increase of peristalsis is followed by a lessened peristalsis. Following the temporary paralysis, the adhesion occurs. The first step in the formation of the adhesion is exudation of serum and change in the endothelial cells. The exudated serum coagulates and forms fibrin, particularly at the edge of the process. At the same time that the fibrin formation is taking place, polynuclear leucocytes escape into the coagulated mass. Within a few hours round cells collect in the fibrin mass. At this time the fibers of the basement membrane begin to loosen and different fibers become entangled with those of the opposing layer of peritoneum. The fibrin formation at the beginning appears to remain and serve as a scaffolding for the subsequent process."

[1] Read before the Western Surgical Association, St. Paul, December, 1916.

Clinically as well as experimentally it has been our observation that there seems to be a direct ratio between the amount of fluid in the inflammatory exudate and the density of the subsequent adhesion. Hertzler calls attention to the greater tendency to adhesions to form subsequent to operative procedure on the lower ileum as contrasted to the jejunum. This probably is a result of the difference in bacterial flora of the upper and lower bowel. It has been my observation in some 200 intestinal anastomoses that any invasion of the lower bowel was almost sure to be followed by adhesions; while the jejunum and duodenum could often be entered without any such consequence.

The causes of adhesions are given by Murphy as chemical or mechanical irritation, or infection. For purposes of presentation we will first consider the rôle of aseptic trauma. From our own work the etiological significance of pure uninfected trauma seems to dwindle. When taken in connection with infection no one can doubt the importance of this element. All of our experiments emphasize the importance of the traumatic factor when taken in conjunction with infection, but minimize it *per se*.

To determine the effect of sterile trauma a series of experiments were undertaken. Sterile section of the abdomen was done in a series of dogs. In these animals the parietal peritoneum and the peritoneal coat of the ileum were abraded with gauze until they bled. The laparotomy wounds were then closed and the animals allowed to recover for varying periods of time. At the autopsies, there were seldom any adhesions either to the omentum or viscera. The peritoneum usually was found glistening and of normal appearance. Microscopic section showed normal investment with endothelial layer. The visceral peritoneum did not present the same appearance. While there were no adhesions between the viscera, yet the peritoneum over the ileum often showed patches of scar tissue. These results were somewhat analogous to those of Dembousky, who traumatized by means of a sterile toothbrush. Vogel's results with cautery were accompanied with no marked adhesions, but were not identical in that superficial cauterization did produce adhesions while black burns did not. Sanger's experiments, where 6 centimeter defects in the peritoneal wall of dogs had been produced, naturally resulted in adhesions. These, so often quoted, can hardly be used as an illustration of ordinary mechanical traumatism. However, other observers have found that even stripping the parietal peritoneum did not often cause adhesions if the work was done aseptically. Sterile gauze when left in the wound undoubtedly causes adhesions.

The use of catgut has been acquitted of the charge of producing adhesions. Yet it is true that linen sutures produce typical anatomical adhesions. A series of experiments were done with adhesions produced by continuous linen suture, and these were studied to determine something of the life history of an adhesion. For this purpose two opposing peritoneal surfaces of the ileum were sewed together with linen. The sutures reached only to the muscularis and were very carefully placed. After such an experiment, at the end of two weeks, the line of suture was densely adherent. Histologically the adhesions differed from no other adhesions. As these animals were repeatedly subjected to laparotomies, it was found that the adhesions stretched out and finally disappeared. This occurrence had its counterpart in adhesions from other causes but this method was used in that it offered a means of accurately recording the changes that took place and that it permitted measurement in centimeters. On the other hand, the changes in unlimited adhesions, or the changes in adhesions from infection could not be accurately recorded, but were a matter of memory and judgment. Therefore, this type of adhesion is used in detailing the natural history of these structures. As the adhesions stretched out, their blood supply became less and less, and to this was attributed their disappearance. Clinically we know that the victim of painful adhesions is only relieved temporarily by operation, that the trouble is very apt to return, and that he may recover if these adhesions are left to their own natural life cycle. These same

suture lines when disturbed by attempts to break them up would be followed by increased production of new adhesions. However, we sometimes find that suture adhesions do not disappear. Usually in these cases the omentum is found plastered to the suture line. The persistence of these adhesions can be explained on the ground of blood supply, as this is usually deficient in adhesions, the omentum readily furnishes surrounding viscera with a new blood supply. Therefore, aseptic trauma of normal parietal and visceral peritoneum does not seem to be followed by permanent adhesions unless the cohesion is augmented by the omentum.

In connection with sterile trauma, E. P. Quain has given a very important contribution to the prevention of adhesions. Part of his work was clinical observation, and part of it a series of experiments carried out at the University of Minnesota. In his experimental work the parietal peritoneum was massaged by a toothbrush and the results noted. In animals where both sides of the peritoneum had been so treated, adhesions were the rule only on the side where the intercostal nerves had been sectioned. Moreover, in some of his experiments that we repeated we found that defects in the parietal peritoneum did not cover with endothelium when the intercostal nerves had been sectioned. Further than this, in many of our right rectus incisions where several of the nerves had been cut we found adhesions that were limited to the denervated area. Therefore, nerve supply seems an important factor in the production of adhesions. Infection alone in our series did not produce as severe adhesions as occurred in infection plus trauma.

Much stress has been laid on the importance of good surgical technique in avoiding adhesions. Wegner and Walthards have shown the deleterious effect of drying of the peritoneum; hence, the value of rapid operating. Thompson has shown the effects of dry gauze left in the tissues. Moore has warned against drainage tubes in that they give access of extraneous infection to wounds. Therefore, drainage should be done only when absolutely necessary. Crile and Carrel have demonstrated the value of delicate handling and the necessity of avoiding all unnecessary gauze manipulation, together with the value of perfect hæmostasis. Strassman has called our attention to the effect of hæmatoma in producing adhesions, and the futility of pedicle stumps has been epitomized by Stimson. Their predilection to cause adhesions is a matter of common observation.

All of this is so familiar that the repetition is banal, but the handling of the infective agent *per se* is usually left to itself and has received but little consideration by the experimental surgeon. I do not wish to minimize the importance of technique but to emphasize the importance of infection in cases where both infection and trauma are combined.

Operations often have to be done in the presence of infection already in the peritoneal tissues, or infected hollow viscera have to be invaded. The density of adhesions with any standard operation carefully performed with due regard to the principles of operative surgery seem to be usually in direct proportion to the amount and character of the infective agent. For instance, in intestinal work the result depends very largely on the flora of the particular region and the amount of that flora that is allowed access to the peritoneum. The important etiological rôle of infection in producing adhesions suggests the necessity for some effort to combat infection in the peritoneal cavity. So far the efforts of the surgeon have been directed more toward selecting the proper time for operation, to selecting advisable routes to the seat of infection, and to the refinements of technique, rather than to combating infection directly. Besides this, advantage has been taken of acquired immunity, but very little has been done in regard to chemical disinfection. Some substances have been tried and condemned; others are yet on trial. Tincture of iodine, recently advocated by Crisler, does not seem to be generally accepted. With our work a 2 per cent solution of iodine painted on the infected peritoneum did not always produce adhesions, but the 3.5 and 7 per cent always did. Carbolic acid, salicylic acid, and bichloride of mercury have all been justly condemned, except when

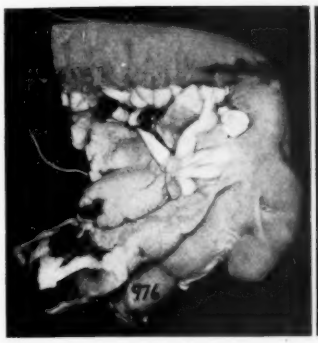


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Specimen 976. Illustration of tendency adhesions have to disappear. Two surfaces of intestine were scratched with needle point in straight line, and sutured along line with fine sutures reaching into muscularis. These examined soon after operation showed dense adhesions along suture line. At autopsy these had completely separated.

Fig. 2. Specimen 979. Illustration of tendency adhesions have to disappear spontaneously. Two surfaces of intestine were scratched with needle point in straight line and sutured along line with fine suture reaching into muscularis. These examined soon after operation showed dense adhesions along suture line. At autopsy these had begun to separate. Operation May 26, 1916. Autopsy September 7, 1916.

Fig. 3. Specimen 984. Repair by formation of scar tissue, without adhesion, in visceral peritoneum. Both parietal and visceral peritoneum had been abraded with gauze until bleeding occurred. Operation September 25, 1916. Autopsy October 6, 1916.

used to sterilize minute pedicles. Normal salt solution in the peritoneal cavity has been recently championed by Clark, and certain experimental evidence has been produced to show that animals are less subject to peritonitis when the inoculating material was diluted with normal salt than when not so diluted. The use of saline as a lavage has had but little effect in lessening peritonitis, as evidenced by postoperative adhesions in our hands. All of the strong antiseptics seem to do harm in the peritoneal cavity and to intensify peritonitis rather than inhibit it. Ether alone offers a possible exception. Hertzler produced adhesions with ether in the peritoneal cavity. For that reason and for its toxic effect, skepticism in the use of that agent is justified. However, ether in our laboratory has not produced permanent adhesions when used alone in the cavity. Clinical usage has promoted the use of ether in combating peritoneal infection. This might be interpreted as meaning the prevention of adhesions. This has received attention from Souligoux and Morestin. Reports favorable to its use appear by De Tarnowsky, Dergnanc, Waterhouse, Phelip, and Tartois, and finally by Lundholm.

In the experimental laboratory, the use of ether following escape of infective material on to the peritoneum does seem to lessen the formation of adhesions. To demonstrate this with the idea of eliminating as far as possible the question of complicated technique, a series of animal experiments was done. In these experiments a hole was made in the lower ileum and the contents of the bowel allowed to escape. Then the hole was closed and the infectious matter was washed out with ether. Some ether was allowed to remain in the cavity. As a result of these experiments, general adhesions were found absent and oftentimes only a little of the omentum had attached to the bowel sutures. Some of these experiments with ether were followed by adhesions. These usually presented a stretched out appearance. It is true that in some of the controls where ether was not used, the adhesions were no more dense, but this was not the rule. Guy-rope adhesions seemed to be more common after the use of ether than without it. In some instances ether seemed to prevent adhesions; in other instances at least to mitigate them. In addition to this, with intestinal anastomoses, fewer adhesions developed as a rule after

Fig. 4.

Fig. 5.

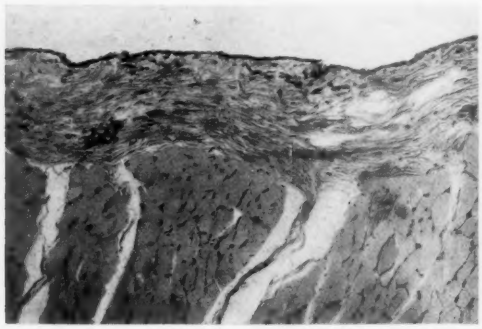
Fig. 6.

Fig. 4. Specimen 988. Adhesions following hematomata in mesentery. Two hematomata were made October 28, 1916, in the mesentery of the small bowel. It was found at autopsy, November 17, 1916, that both of these had formed adhesions.

Fig. 5. Specimen 987. The cure of adhesions with knife. This animal had numerous adhesions between coils and mesentery of bowel without involvement of omentum; the result of faulty intestinal anastomosis. On September 28, 1916, they were separated by sharp knife dissection. The plate shows condition October 28, 1916, at autopsy.

Fig. 6. Specimen 721. The effect of cutting intercostal nerves on repair of peritoneum. Analogous to section of nerves in right rectus incision. Quain experiment. Midline incision. Peritoneum scarified on either side. Intestine allowed to dry and handled with gauze. The ninth, tenth, eleventh, and twelfth nerves cut on one side. Operation April 8, 1915. Autopsy May 20, 1915. Adhesions limited to denervated areas of peritoneum.

the use of ether lavage than did without it. It is difficult to substantiate the claim that ether is an antiseptic of sufficient power to destroy infection. Ether is usually vaporized in the peritoneal cavity after a very short time. Test-tube experiments by Topley with agar cultures required a three-hour contact with ether vapor to kill bacilli coli and streptococci, while the staphylococci required five hours. On the other hand, suspension in liquid ether practically destroyed the bacillus coli after one minute shaking. As to the advisability of the use of ether, Saliba reports favorably on its use in 240 cases of peritonitis. In this series, ether poisoning was encountered twice and one of the cases



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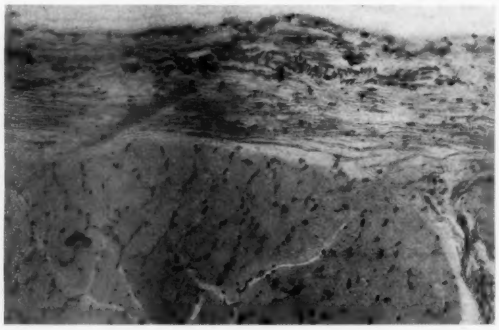

B

Fig. 7. Specimen 795. Importance of nerve supply in repair of denuded peritoneum. *A*. (At left). Section taken to show repair of peritoneum over defect made in peritoneum with toothbrush in presence of infection. Nerves in this side were intact. *B*. Section taken to show lack of repair of peritoneum over defect made in peritoneum with toothbrush in presence of infection when this area had been denervated.

was complicated by pneumonia. Waterhouse has reported 60 cases, with 2 of ether poisoning and 2 of pneumonia. The work of these men has established the proper dose of ether in the peritoneal cavity. It should never be more than half an ounce for children under two years, and three ounces in adults; larger doses produce ether poisoning.

In combating infection, some mention must be made of the cautery. Cautery burns, if properly made, do not produce adhesions, and the cautery is justified whenever it is possible to use it in cutting through infected tissues.

Sterile blood is ordinarily very rapidly absorbed from the peritoneal cavity without clotting, as is shown by Hertzler. The rate of absorption has been shown by Buxton and Torrey. However, infected blood does not act in this manner, and Hertzler states that blood-clots are not so benign. In our experiments when sterile blood, or even blood-clots, were allowed to remain in the abdomen marked adhesions did not follow. However, hæmatomata in the mesentery of the bowel almost invariably were followed by dense adhesions. To illustrate that, a simple needle puncture was made in the mesenteric vessel and hæmatomata allowed to form. No hæmostasis except gentle pressure was employed. Invariably subsequent section showed these hæmatomata to be definitely attached to some surrounding structure. Strassman has also considered hæmatomata as predisposing to adhesions.

The omentum may perform a benign function or an unfavorable one. Neuhof and Wiener have shown that the omentum and particularly the free edge of the omentum, has the power of being insinuated in needle hole punctures and finding attachment there. They also found that the free uncut edge of the omentum had a predilection to cover any raw or infected surface. This is benign in preventing adhesions between viscera and to the parietal wall, or at least has the advantage of making them more mobile. However, in cases when the omentum attaches lower down in the pelvic region, it may produce trouble by traction on the transverse colon. This emphasizes the necessity of utilizing the omentum to advantage so that it may cover raw surfaces without extra traction. Clark has called attention to certain important facts in selecting the field for our adhesions to occur. Clark emphasizes these principles: Traction on the omentum may drag down the colon or the pyloric end of the stomach, or convert the superior mesenteric artery into a constricting band. The resulting deformities cause symptoms. Further, adhesions near the small bowel, except at the duodenal junction and at the pelvic portion of the ileum, are not likely to produce symptoms. Kinking or adhesions of the large bowel to the parietes, or adhesions of the small bowel to the parietal peritoneum are capable of producing symptoms. This partly answers the question of the advantage of postural treatment during convalescence. In addition, if the organs must be fixed, there seems to be some advantage in fixing them in such a position that pain will not

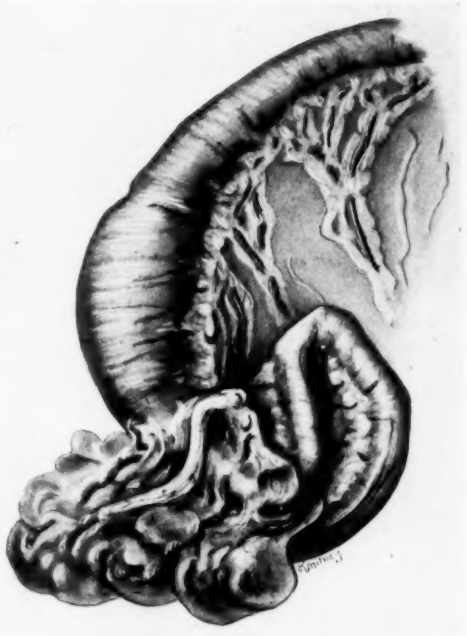

Fig. 8. Specimen 989. A piece of celloidin membrane was wrapped about bowel. Note adhesions and partial intestinal obstruction.

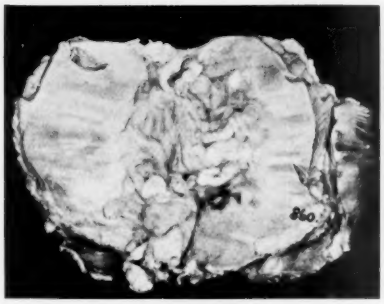

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 9. Specimen 860. Free transplant of omentum to cover raw places subsequent to separating adhesions from anterior abdominal wall. Operation December 12, 1915. Autopsy December 18, 1915. No visceral adhesions to transplant.

Fig. 10. Specimen 1047. Use of ether in prevention of adhesions. A hole was made in terminal ileum and 8 ccm. of intestinal contents allowed to escape. Ether was placed in peritoneal cavity and the laparotomy wound was closed. Operation November 16, 1916. Specimen recovered by operation November 28, 1916. Adhesions generally absent. Omentum fastened to one place to bowel.

Fig. 11. Specimen 995. Use of ether in prevention of adhesions. A hole was made in terminal ileum and 8 ccm. of intestinal contents allowed to escape. Ether was used as lavage and small amount left in peritoneal cavity. Operation November 21, 1916. Autopsy December 7, 1916. Two coils of intestine were found bound together with weblike adhesions.

occur when the patient is standing. The Fowler position in a measure accomplishes this, and in addition Clark advocates weighting down the sigmoid and the rectum with fluid. When adhesions are unavoidable, we may gain much for the patient by selecting the proper site for them. This is emphasized by Reichelderfer in postural treatment. In support of this, he cites a case of a girl who had been operated upon ten times for adhesions. He directed his efforts toward postural localization of adhesions, accomplished by allowing the patient to convalesce in the sitting position. After her last operation she was free of any unpleasant symptoms.

The utilization of the omentum is desirable if it can be done without producing traction. Therefore, the free omental graft first described by Senn, and later in full development treated by Freeman and Mann, commends itself. To determine the exact fate of the transplanted omental graft, Dr. John Halgren of the University of Minnesota conducted a series of experiments. These were awarded the prize in surgery, but have not as yet been published. Halgren's studies showed that the omentum could be transplanted; that the transplanted omentum gave up its fat and finally became a mass of connective tissue. The omental transplant did not give a smooth peritoneal surface in any case. Adhesions about the transplanted omentum invariably occurred, but they were benign adhesions in that they were mobile and never caused obstruction or traction on painful structures such as the parietal peritoneum or mesentery. He further found that their use in the presence of infection is undesirable, as sloughing of the entire mass will occur. Therefore, their use seems limited to covering raw surface, and to give mobile adhesions between anatomical structures. The use of the omental graft seemed very superior to the use of other substances such as Cargile's membrane or Prime's celloidin membrane. Both of these substances produced adhesions, and in the presence of infection greatly augmented the infection. Craig and Ellis after experimental work do not approve of the same.

Oil in any of its forms does not seem to prevent adhesions except when it is used as a covering to silk packing material. Sweet, after careful investigation, has objected to oil in that it seems to disturb the function of the leucocytes. Gellhorn, Blake, Claypool, and Wilke have given various explanations

for failure of some particular oil but do not agree as to what the proper substance may be.

I wish to acknowledge the assistance that Mr. A. D. Hawkins has rendered me in performing some of the special experiments.

CONCLUSIONS

1. Adhesions are benign in their intent but may become perverted.

2. Adhesions, if left alone, tend to disappear spontaneously.

3. Of the various etiological factors infections seems to be the most important.

4. Trauma intensifies the effect of infection.

5. Ether seems to be the most satisfactory chemical means of combating infection. It is not devoid of danger, and is not always effective.

6. Postural treatment is an important question in minimizing the symptoms of adhesions.

7. Omental grafts may be used in covering raw surfaces, but should never be used in the presence of infection.

8. The use of citrate and oil does not seem to be justified.

9. Foreign bodies, such as Cargile's membrane, in themselves produce adhesions, and oftentimes very undesirable adhesions.

10. Hæmatomata are a cause of adhesions.

11. The cautery is a useful agent in preventing adhesions.

12. Section of nerves as may occur in the right rectus incision predispose to adhesions.

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WEBS AND POUCHES OF THE ŒSOPHAGUS, THEIR DIAGNOSIS AND TREATMENT[1]

By HARRIS PEYTON MOSHER, M.D., F.A.C.S., Boston

THE following paper on webs and pouches of the œsophagus is mainly clinical and so lacks the measured and regular steps leading up to a foregone conclusion of academic writings. But little will be said on the etiology of these conditions because but little is known, and the anatomical description of the upper end of the œsophagus will be summarized rather than given in detail. Perhaps the chief reason for writing the paper is to put on record a method of treating œsophageal pouches by cutting the common wall between the pouch and the œsophagus. As far as I know this is a new operation. It has worked well in three cases.

Pouches and webs of the œsophagus, while not common, are not excessively rare. In the past fifteen years I have seen perhaps seven cases of webs of the œsophagus and some ten cases of pouch. In the past twelve months I have had three œsophageal pouches, all of which have been cut. I have limited myself to these two diseases of the upper end of the œsophagus in spite of the fact that at this point they are not so common as stricture or malignant disease. Malignant disease is generally inoperable and is a discouraging and ghastly subject. We have long known how to deal with strictures.

ANATOMY

The chief point in the anatomy of the upper end of the œsophagus for our present purposes is the fact that the outer or longitudinal coat of the œsophagus splits into two vertical bundles on the posterior surface of the œsophagus a short distance below the cricoid cartilage. These two bundles diverge leaving a V-shaped space between and then turn around the sides of the upper part of the œsophagus to gain an attachment anteriorly on the median raphé of the body of the cricoid cartilage. This V-shaped space is

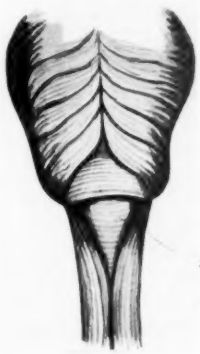

Fig. 1.

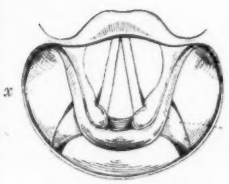

Fig. 2.

Fig. 1. Drawing to show the posterior surface of the inferior constrictor muscle and of the upper part of the œsophagus. Triangular weak area (*x*) at the upper part of the œsophagus.

Fig. 2. Diagrammatic drawing showing two symmetrical webs in the pyriform fossæ. Each web sprang from the back of the cricoid cartilage about a quarter of an inch below the arytenoid cartilage. At the level of the lower edge of the cricoid cartilage, there was an annular stricture with a central lumen a quarter of an inch in each diameter. The etiology of the webs and the stricture in this case was diphtheria.

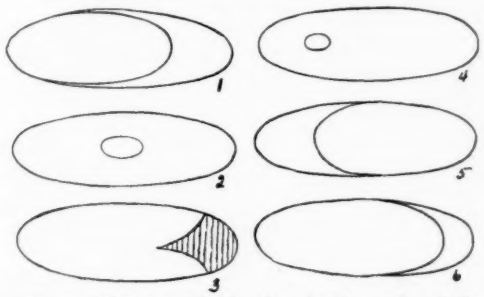

Fig. 3. Diagrammatic drawing showing webs of the œsophagus. *1*, A small crescentic web springing from the right side of the œsophagus. *2*, A nearly complete web with a small central perforation. The drawings in the right column are from a case which had three webs back of the cricoid cartilage; the first nearly filling the lumen of the œsophagus. The small opening was placed to the left of the median line. On divulsing this web a smaller crescentic web, *5*, was found on the left side of the œsophagus. Below this there was a smaller and third web. *3*, Triangular area which results after a web such as is shown in *6* is divulsed.

[1] Read before the Clinical Congress of Surgeons of North America, Philadelphia, October 25, 1916.

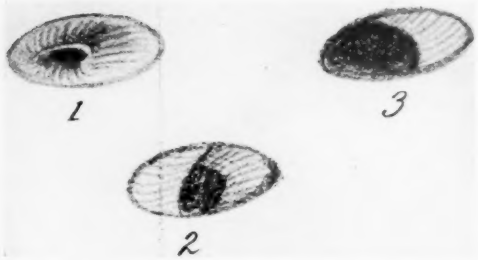

Fig. 4. Drawings to illustrate three webs found back of the cricoid cartilage; *1*, was the first and the largest stricture; *2*, the second, and *3*, the third. Typhoid fever was the probable cause of the webs.

filled by the circular fibers of the œsophagus and they are not reinforced by the extension downward of the lower fibers of the inferior

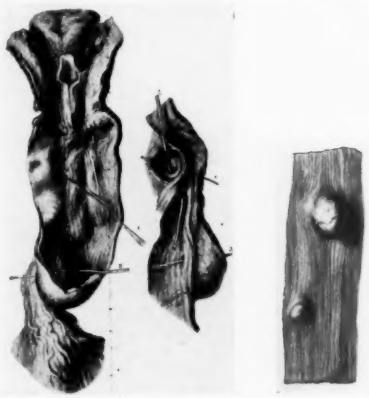

Fig. 5.

Fig. 6.

Fig. 5. Specimen of a very large œsophageal pouch from a boy of 14. (Warren Museum, Harvard Medical School.) The larger drawing shows the pouch opened from behind. There are two openings from the pouch into the œsophagus (probes *A* and *B*). The lower opening from the pouch into the œsophagus may have been due to ulceration as there is much scar tissue about it. In the smaller drawing, probe *A* is passed from the œsophagus into the pouch by the upper opening as in the larger drawing. Probe *B*, as in the larger drawing, passes from the lower opening into the œsophagus from the bottom of the pouch. Probe *C* passes down through the constricted œsophageal opening into the œsophagus. Below this opening the œsophagus was about half its normal width. Notice how far below the cricoid cartilage the upper opening from the pouch into the œsophagus is. In this case extensive cutting of the common wall between the pouch and the œsophagus would have been feasible.

Fig. 6. Specimen of an œsophageal pouch (traction diverticulum). (Warren Museum, Harvard Medical School.)

Fig. 7. Specimen of an œsophageal pouch which was removed by the external operation by Dr. M. H. Richardson. (Warren Museum, Harvard Medical School.)

constrictor. This triangle, as first pointed out by Killian, is a weak spot (Fig. 1). In swallowing, the cricoid cartilage is pulled strongly back against the vertebral column like a cartilaginous stopper. Clinically the muscular fibers which surround the mouth of the œsophagus have a sphincter-like action, although it has been disputed that there is an actual sphincter. The way the mouth of the œsophagus closes above a coin in a child's œsophagus lodged back of the cricoid cartilage gives a strong impression of a sphincter.

WEBS OF THE UPPER PART OF THE ŒSOPHAGUS

Webs of the œsophagus are thin folds of mucous membrane and scar tissue. They are generally roughly crescentic and occur at the entrance to the œsophagus behind the cricoid cartilage. My last web case was examined about ten days ago. It showed a pair of webs. They were symmetrically placed (Fig. 2). Each web was situated below the corresponding arytenoid cartilage in the upper part of the pyriform sinus. In this case also there was at the lower border of the cricoid cartilage an annular scar-tissue stricture with a central lumen both diameters of which were a quarter of an inch. The patient gave a

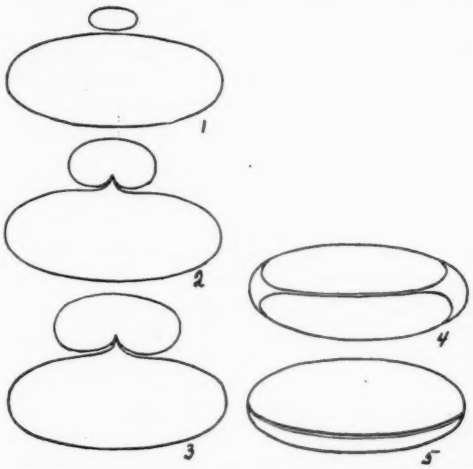

Fig. 8. Diagrammatic drawing to show the effect of cutting the common wall between the œsophagus and an œsophageal pouch. These pictures are obtained through the œsophagoscope. *1*, Shows the small opening of the œsophagus anteriorly and the large opening of the pouch posteriorly. *2*, Shows the lumen of the œsophagus becoming wider after the first cut in the common wall. *3*, Shows the lumen of the œsophagus as it is becoming still wider after the second cut. *4*, After liberal incision of the common wall, the lumen of the œsophagus and the pouch become of the same size, and the common wall stretches across the lumen of the œsophagoscope as shown in the figure. *5*, In this figure the common wall has been cut to within a quarter of an inch of the bottom of the pouch. The cutting is stopped here for fear of opening the posterior mediastinum. Cutting to this point completes the operation. The common wall has gradually drawn nearer the posterior wall of the pouch until as in this diagram it is almost in contact with it. By ballooning and examining with a probe it is easy to make out just how much of the pouch has remained uncut.

history of diphtheria when she was 14 years old, followed by paralysis of the palate. Small webs like these are in my opinion commoner than we suppose. I feel that a large percentage of cases of globus hystericus are webs. The old fashioned blind passage of a bougie in these cases cured the patient by breaking the web. The modern dictum is that all cases of difficulty in swallowing should be examined with the œsophagoscope. Webs are due to scar tissue which forms on an abrasion caused by trauma or by any disease which, like pneumonia, diphtheria, typhoid fever, or pemphigus, may produce ulceration of the pharynx or œsophagus. Years ago I had one case of narrowing of the whole length of

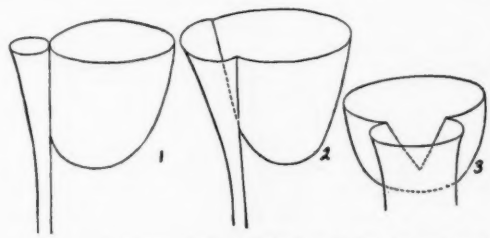

Fig. 9. Diagrammatic drawing to show the result of cutting the common wall between an œsophageal pouch and the œsophagus. *1*, An œsophageal pouch with its large lumen and the œsophagus with the small opening which the œsophagus has when associated with a pouch. *2*, The effect of cutting two-thirds of the common wall between the pouch and the œsophagus (seen from the side). *3*, The effect of cutting the common wall between the œsophageal pouch and the œsophagus (seen from the front).

the œsophagus in a patient who, during an attack of pneumonia, suffered from extensive ulcerations of the mouth and pharynx. One case in which a large web of the upper part of the œsophagus was found gave a history of typhoid fever six years before and still another case of web gave a history of diphtheria. Ulcerations produced by the burn of hot food and the bruise caused by the temporary lodging of a sharp bone might start a web. In my cases the webs have varied in size from an insignificant triangular fold to those sweeping across two-thirds the lumen of the œsophagus. I have had one web which took the form of a thin diaphragm with a central opening, and one case in which the first web was followed by two smaller webs one right and one left, and all three placed behind the cricoid cartilage. The first and third webs were on the right and the second on the left. The first was the largest, the second smaller than the first and third the smallest of all.

Symptoms. A small web may give no symptoms or, in fast eating, enough fluid or food may be held back momentarily to cause an overflow into the larynx and consequent choking or strangling. Large webs produce definite obstruction so that the patient is finally reduced to a liquid or a minced diet and goes to the table in terror or eats alone also in fear. In time such people become very thin from lack of sufficient nourishment.

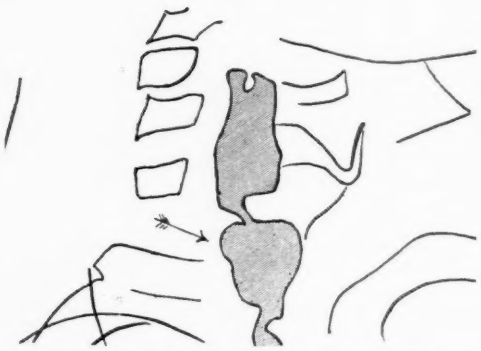

Fig. 10. Tracing of an X-ray plate of an œsophageal pouch (Mr. S.) before operation. Notice the large bolus of bismuth just above the pouch. Anteroposterior plate. Arrow points to pouch.

Diagnosis. I feel that I shall be taken to task for advocating the ether examination of all patients with suspected webs of the œsophagus. Nevertheless this is my position. If the examination is made without local anæsthesia or for that matter with it, and with the small tubes which this method of examination entails, the chance of finding a web is small. In the early days of œsophagoscopy it happened a few times both to me and to some of my colleagues to examine cases of slight difficulty in swallowing without finding the cause of the trouble. Nevertheless the negative examination, ether examination I am speaking of, was followed by a disappearence of the patient's symptoms. I remember two cases in which the introduction of the tube was hard. It finally entered the œsophagus but its introduction was followed by a little bleeding. When the blood was wiped away a triangular slit was seen in the œsophageal mucous membrane. Such cases were in my opinion unrecognized webs in which the pressure of the end of the œsophagoscope had, unbeknown to the examiner, divulsed the web (Fig. 3).

Treatment. Once the position and the nature of the web has been made out under ether with the aid of the ballooning œsophagoscope, the treatment is very simple. The end of the œsophagoscope is pressed firmly against the outer edge or rim of the web and the inner or free edge centered at the opening of the examining tube. When the web is thus made taut a scissor punch or a knife previously placed in the operating window plug is put in position and the free edge of the web is incised. This done the end of the œsophagoscope is pushed down hard against the partly divided web. Generally the pressure of the tube divulses the rest of it. If it does not the web can be again cut. The cut and the slit seem to go through only the mucous membrane and scar tissue of the web. As yet I have had no infection following this method of dealing with webs.

After-treatment. For two days nourishment is supplied by enemata. On the second day sterile water is allowed by mouth and on the third day, no reaction following the operation, broths are given, and the enemata stopped. For the first week the patient is given twenty grains of subnitrate of bismuth four times a day with the idea of coating the raw surfaces and thus perhaps minimizing the chances of infection (Jackson). On the seventh day as large a bougie as will easily pass is introduced. Such a bougie is passed twice a week for a month. After this time the patient's ability to swallow must be the guide to the intervals of using the bougie. Intelligent patients can be taught to pass the bougie on themselves. The bougie may have to be passed at intervals for years; perhaps, as in strictures, for the rest of the patient's life.

Results. After cutting or divulsing a web there is generally no reaction. For the first few days the patient complains of a sore throat and indefinite discomfort sometimes amounting to actual pain behind the sternum. The temperature chart is almost flat. By the fourth day all discomfort has disappeared and the patient is taking semisolids without trouble and by the end of a week is eating normally. The joy of these patients at being restored to normal eating is pathetic. The satisfaction of the operator is not inconsiderable.

DIVERTICULUM OF THE ŒSOPHAGUS

In his latest book Jackson divides diverticula of the œsophagus into traction and pulsion diverticula. The traction variety is

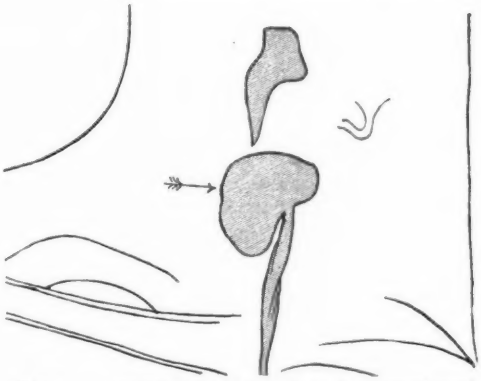

Fig. 11. Tracing of an X-ray plate of an œsophageal pouch (Mr. S.) ten months after slitting half of the common wall. Notice the widening of the upper third of the pouch. Anteroposterior plate. All difficulty in swallowing has disappeared and a No. 48 English bougie passes easily. Arrow points to pouch.

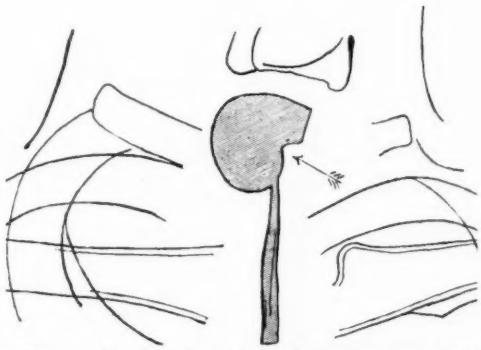

Fig. 12. Tracing of an X-ray plate of an œsophageal pouch (Mr. S.) ten months after slitting half of the common wall. Notice the widening of the upper third of the pouch. Anteroposterior plate. All difficulty in swallowing has disappeared, and a No. 48 English bougie passes easily. Arrow points to pouch.

situated usually within the thorax and is due to the adherence of cicatricial tissue; the pulsion diverticulum is situated in the neck but may extend to the upper thoracic aperture (Fig. 5).

Traction diverticulum of the œsophagus. Traction diverticulum of the œsophagus is a rare condition, rarely gives symptoms and is rarely discovered. A traction diverticulum is a one-sided enlargement of the œsophagus. This may form a true pouch as the specimen shown in Fig. 6 shows. Usually, however, this is not the case. Jackson quotes Keith on the etiology of traction diverticula as follows:

> First there is a localized adhesion of the œsophagus to the surrounding part, usually due to inflammation of one of the bronchial glands.
>
> Second, traction of this adhesion occurs during coughing, deep inspiration, and deglutition. In these acts the trachea and the œsophagus move independently and elongate the adhesion formed between them with the result that traction diverticula of the œsophagus are formed.

Pulsion diverticulum of the œsophagus. Pulsion diverticula, again quoting Jackson, are usually small and may not have a capacity of more than 1 or 2 cubic centimeters. On the other hand, they may be large enough to bulge out the neck like a goiter. In the three last cases which I have had all were centrally located. Two were about an inch long and extended half way to the clavicle. The third measured two inches long and reached the lower edge of the clavicles. Pulsion diverticula are seldom seen before middle age.

Pulsion diverticula are usually said to be due to a hernial protrusion of the œsophagus through the weak triangle of the posterior wall and are caused by the pressure of innumerable boluses of food. A cicatricial stricture at the beginning of the œsophagus might in some cases be the starting point of a pulsion diverticulum or pouch. In the last œsophageal case that I examined there was an annular stricture at the mouth of the œsophagus, and behind this was an indication of a beginning pouch. Congenital pouches have been reported, and Semon reports a congenitally deformed larynx which was accompanied by a pouch.

If I am not mistaken embryologists have described pouches at the beginning of the œsophagus. When you look into a pouch the whole pharynx seems to be lowered and the idea persists in my mind that some diverticula are due to the attempt to form a double œsophagus. At the present moment the hernia theory is the one that has the most adherents. Once a pouch is started everything conspires to make it enlarge.

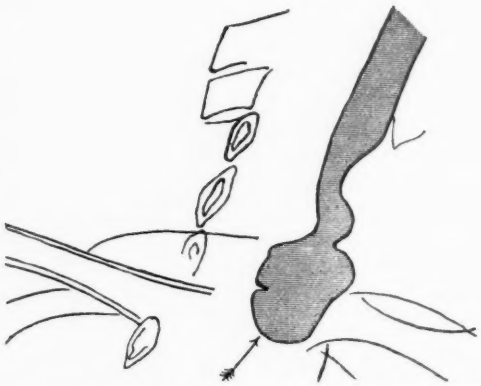

Fig. 13. Tracing of an X-ray plate of an œsophageal pouch (Mr. M.), before operation. Anteroposterior plate. Notice the large bolus of bismuth above the pouch and the constriction in the side of the pouch. Two-thirds of the common wall were cut, and today, five months after the operation, swallowing is still normal, and a No. 48 English bougie passes easily. Arrow points to pouch.

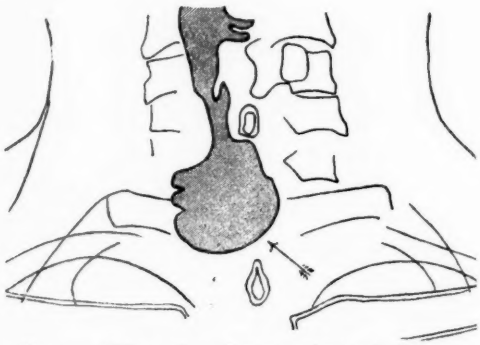

Fig. 14. Oblique plate of same patient as in Fig. 13.

Symptoms. The symptoms of a pouch are gradually increasing difficulty in swallowing, until, in advanced cases, the patient is reduced to a liquid and minced diet. Eating is accompanied by strangling and this is followed by the return of some of the food just swallowed. If the pouch is a large one the patient has to leave the table periodically and by gagging and vomiting empties the contents of the pouch. Shortly after eating in some cases or in a few hours in others, the patient brings up undigested food. There is a feeling of fullness in the region of the clavicle and a sound of gurgling as if air were imprisoned in the œsophagus. At times food is returned which has been in the pouch for some days. At night the pouch tends to empty itself and the irritation of this causes more or less coughing and strangling. Pain is never in my experience complained of. As the pouch gets larger and the opening of the œsophagus smaller, the patient swallows with more and more difficulty and eats more and more alone. The patients manage to get enough food to live but they are usually thin to scrawniness. I have never seen a patient who was fat who suffered with a pouch. Meal time is one of loneliness, dread, and disgust.

Diagnosis. If a patient with an œsophageal pouch is examined with the laryngeal mirror and the examiner presses on either side of the patient's larynx one or both of the pyriform sinuses will be seen to overflow with a frothy, dirty fluid. The larynx appears normal as a rule but may be reddened. I pass over with the bare mention of them the old methods of making a diagnosis of œsophageal pouch by filling the pouch with shot and then taking an X-ray or by attempting to pass a bougie only to have it halt at the level of the clavicle and then on withdrawal and reinsertion, passing after many attempts on the part of the surgeon and much gagging on the part of the patient, into the œsophagus. In most cases it is impossible to pass a bougie however small. The three modern methods of determining the presence of a pouch are the fluoroscope, the X-ray plate after swallowing bismuth paste, and the examination of the upper part of the œsophagus with the ballooning œsophagoscope. If the act of swallowing bismuth milk is watched with the fluoroscope the pouch will be seen to fill and to make a small rounded tumor above the clavicle. When the pouch becomes full a thin stream trickles from it into the œsophagus. This stream continues thin for about the length of the pouch and then the œsophagus swells out to its normal size. Is this narrow part of the œsophagus behind the pouch due to the pressure of the full pouch or is there an element of true stricture in the upper part of the œsophagus? The behaviour of the pouch under cutting rather favors the idea that there is an element of stricture in the narrowed œsophagus. The

fluoroscope shows the pouch to the trained eye, the X-ray plate shows it to the untrained. The anteroposterior plate gives a globular tumor in the median line, the lower border of which is at or just above the inner end of the clavicles. It measures in the vertical diameter from an inch to two inches and in the transverse diameter about half an inch to two inches. The only certain way to make out a pouch is to see it by aid of the œsophagoscope, and the best method, and I say this with all the emphasis at my command, is to examine under the relaxation of ether with a large oval œsophagoscope with a ballooning attachment. I feel at times when speaking of the ballooning attachment of the œsophagoscope like a voice crying in the wilderness, but I shall continue to cry on.

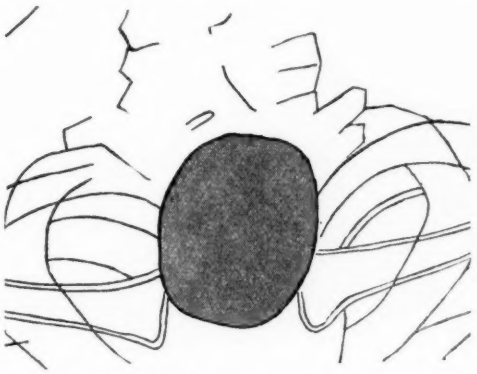

Fig. 15. Œsophageal pouch. Mr. F. 71 years old. Tracing of an anteroposterior X-ray plate. Very nearly all of the common wall was cut at operation.

Examination with the ballooning œsophagoscope. The patient is given a preliminary dose of atrophine and morphine. I have been a little uneasy about the use of morphine since Jackson has spoken so strongly against it as abolishing the protective cough reflex, but still use it. Atrophine dries up the secretions of the trachea, bronchi, and of the œsophagus. I have clung to the theory advanced by Crile years ago that atrophine blocks off the pharyngeal and vagus reflex. So far in œsophageal examinations of any and all kinds I have had no trouble from the morphia, none from the vagus reflex, and none from the examination under ether. I have been astonished many times that the œsophagus tolerates the large tube, and that there is no interference with the larynx either reflexly or from pressure. Once the examination is started it is very seldom that the tube has to be withdrawn. The ideal method of giving the anæsthetic is by a catheter placed in the trachea.

The patient is placed on the table on his back with the head hanging over the end and the head held by the Boyce method except that no gag is used after the tube is inserted. A short, nine-inch, oval œsophagoscope is employed. This is carried down by sight to the bottom of the right pyriform fossa and behind the cricoid cartilage and then swung into the middle line. It always falls into the open mouth of the pouch. A bougie always does the same when passed without or with ether. The pouch is easy to find. The operator makes sure that he is in a pouch by ballooning it. He discovers that he is in a closed sac, with no opening ahead. The tube readily passes to the bottom of this and halts. On removing the window plug and measuring the level of the bottom of the pouch by laying it off on the patient's neck it will be found that the usual pouch stops at the level of the clavicles or a short distance above. The pouch is cleaned either by swabbing or by washing it out through the tube with the foot of the table raised, or best of all the contents are sucked out by an electrically driven suction apparatus. This apparatus is essential in all except the most casual œsophageal work. The walls of the pouch may not be unlike the walls of the œsophagus except for the fact that they are generally redder. The whole pouch lining is sometimes smooth. It is more common, however, to find the bottom of the pouch ribbed with small fibrous trabeculæ. In many cases if the bottom of the pouch is grasped with forceps the sac can be turned wrong side out like a glove finger. While Jackson's book was in press and before I began to cut the common wall between the pouch and the œsophagus I tried to devise some operation which would obliterate a pouch by turning it wrong side out and either clamping or suturing it. This manipulation would be easy for Lynch

but hard for most of us. Cutting, however, is easier and for the moment I am confining my attention to this and shall continue to do so until I prove the end-results of cutting. But to return to the examination. The examiner finds that he is in a pouch by ballooning. He determines the condition of the pouch and its size and then begins the hunt for the lost œsophageal opening. In my experience, the opening of the œsophagus is always placed anteriorly and it is always round and small; so small in fact, that it will not show as an opening unless the point of the tube is turned well upward and air forced strongly into the tube by the foot bellows. It is in finding the opening of the œsophagus that the ballooning is most useful. By its aid the pouch is found first and then the tube is slowly withdrawn and pressed firmly upward, the assistant meanwhile strongly working the foot bellows. At the moment that the tube slips out of the mouth of the pouch, the examiner sees to his joy in the median line, at twelve by the clock, a small dimple. He at once centers this in the opening of the tube and presses downward. As he does so the dimple becomes a hole and the œsophageal opening is found. He now puts the operating window in place with a probe or a small bougie in it, and all the time keeping the œsophagus open by air pressure, passes the probe down the œsophagus. Sometimes continued pressure of the mouth of the tube reinforced by strong ballooning will soon allow the end of the œsophagoscope to enter the œsophagus; at other times a dilator has to be passed into the œsophagus and the mouth of the œsophagus stretched before the tube will be admitted. Once the tube has passed into the œsophagus, the short tube is replaced by a full length tube and the whole length of the œsophagus explored for further pathology. In pouch cases it is not usual to find any other abnormality.

Jackson speaks of the œsophageal opening in pouch cases as the subdiverticular opening. The pouch is really a continuation of the pharynx downward, but as you examine these cases under ether and with the ballooning œsophagoscope the pouch has a distinct orifice which looks like the normal œsophagus as it opens ahead of the tube. It is only when the tube is found to halt in a blind sac that it is seen that there is a pouch present. When the tube is withdrawn the distinct mouth of the pouch appears again and at the level of this, the opening of the œsophagus is found.

Treatment. There have been two methods of treating œsophageal pouches; first, to find the œsophageal opening and dilate it and then keep the dilatation by the passing of bougies, at first by the physician and then for an indeterminate time by the patient himself; second to dissect out the sac by external operation. I became interested in œsopheal pouches through the use of the œsophagoscope. I found that the simple procedure of ballooning easily revealed the œsophageal opening and that it was easy to dilate the mouth of the œsophagus. Up to a few years ago the cases which fell into my hands were managed in this way. All the cases except one were able after the dilatation of the mouth of the œsophagus to pass the bougie for themselves and all have disappeared from observation except one. There will be more about this one later. How many of these bougie cases have finally become tired of the constant passing of the bougie and have had their pouches dissected out I do not know. The one case of dilatation (Pouch Cases, Case No. 4) which has remained under observation was improved by the stretching of the mouth of the œsophagus for a few months but finally shut down so that no manipulation with which I was familiar enabled me to pass any type of bougie, staff, or probe into the mouth of the œsophagus. This case has just had the common wall cut. The method of dissecting out the œsophageal pouch is a thoroughly scientific procedure perhaps the most scientific of all. It gives good results in most cases. Pouches do, however, return after dissection, and old statistics give the mortality of the operation as 10 per cent.

Many cases I understand are done in this way at the Mayo clinic. I have no quarrel with it. All who try the dissecting method should take advantage of an improvement in technique brought about by the use of the

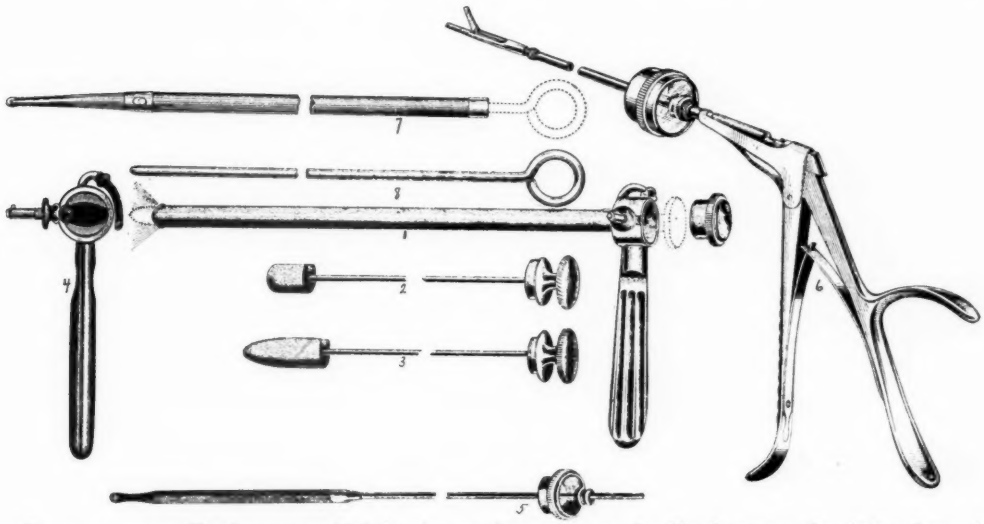

Fig. 16. *1*, *2*, *3*, *4*, Œsophagoscope with ballooning attachment. *1*, *2*, and *3*, Œsophagoscope, the window plug, and two obturators. The obturators are seldom used as the tube is practically always passed by sight. *4*, An end view of the œsophagoscope. The window plug is not in place. The accessory tube for ballooning leaves the main tube at the top. From this, rubber tubing leads to a foot bellows. *5*, The operating window plug. The cuts show the operating window plug through which a staff tipped with a bougie has been passed. This plug permits the use of any instrument which has the proper shaft. The operator has the advantage of constant ballooning while he is working. *6*, *7*, and *8*, Œsophageal instruments. *6*, Shows the scissor punch in place in the operating window plug and ready to adjust in the œsophagoscope. *7* and *8* show a deflation bougie for letting air out of the stomach should the stomach become overinflated during ballooning of the œsophagus. A stylet (*8*) stiffens the bougie so that it can be inserted quickly. So far I have never had to use this bougie. Generally on removing the window plug the air returns with a rush from the stomach through the œsophagoscope. During the ballooning one assistant watches the stomach and warns the operator when it is markedly distended. So far the pressure of the distended stomach has not interfered with the action of the heart.

œsophagoscope (Jackson-Gaub). This consists in one operator finding the pouch with the œsophagoscope and by pressure outward with the end of the tube outlining the pouch for the operator as he dissects down upon it from the outside. Two such cases are reported in Jackson's latest edition of his book[1]. Of our Boston surgeons Dr. Mixter has had the largest experience with the treatment of pouches. His view is that small pouches in young people should be dissected out, whereas pouches in old people or pouches which are large enough to invade the thorax should be managed, if possible, with the bougie.

Six or seven years ago I began to wonder what would happen if the surgeon should cut the common wall between the pouch and the œsophagus. I told Dr. Mixter that I hoped to cut this wall some day and he replied that he had thought of the same thing. As he did not use the œsophagoscope he did not have the means of cutting it. Working with the œsophagoscope aided by ballooning I found that I had. What deterred me was the fact that I did not know what vessels or nerves ran in the common wall. In normal anatomy there should be no nerves or vessels of importance there. Still there might be vessels of sufficient size to give trouble. The possible infection of the posterior mediastinum seemed the greatest danger. Mediastinatis is more deadly than either peritonitis or menigitis. In the dissecting-room I have hunted in vain for specimens of œsophageal pouch so that I could orient myself from them. In the Harvard Medical School Museum there is but one specimen of this kind (Fig. 5). By studying the pouch cases that came

[1] Pages 550 and 560.

under observation, by ballooning them and turning them inside out, I became convinced that there was nothing of surgical importance in the common wall, so three years ago I nicked it and then this past year cut the wall half through in one pouch case, two-thirds through in another, and in my third and last case practically all of it was cut. The mediastinum did not show the slightest tendency to infection in any of the cases. The details of these cases I shall come to in due order. In all of these cases there was complete relief of the clinical symptoms.

THE TECHNIQUE OF CUTTING THE COMMON WALL

The first step toward cutting the common wall is to locate the opening of the pouch and the opening of the œsophagus, doing so under ether with the ballooning œsophagoscope. Then with the operating window plug through which the scissor punch is passed the common wall is brought out so that it bisects the transverse diameter of the œsophagoscope and then the first cut is made in the center of it. The incision which the punch makes is about a quarter of an inch long (Fig. 8). There is but slight bleeding. The forceps and operating plug are then removed and a clear field is obtained by suction. After replacing the forceps and the plug, and balloon again, the œsophagoscope is pushed a little further down and a second cut is made. These manipulations are repeated until the common wall is slit to within an eighth of an inch of the bottom. This small rim is left at the bottom of the pouch to wall off the mediastinum or rather to avoid opening it. If the œsophagus and the pouch do not lie close together, or rather if they are not actually glued by old inflammatory adhesions, the mediastinum will have been opened by this first cut. Probably every pouch is walled off by adhesions posteriorly. Theoretically at least the patient and the operator have to take the risk of opening the posterior mediastinum. All that I can say is that so far no infection has followed the cutting in four cases. After the first cut the œsophagoscope slips into the œsophagus readily and, of course, continues to do so. As the cutting proceeds the cavity of the pouch becomes smaller and smaller until nothing is left but a small crescentic rim to show where the common wall was (Fig. 9).

The postoperative care. The patient is starved for twenty-four hours before operation and given four doses of subnitrate of bismuth of twenty grains each during this day (Jackson). During the operative manipulations the patient is kept with his heels higher than his head. He is put to bed in this position and kept this way for a few hours. He is fed by rectum for two days. During the first day he has nothing by mouth except the four doses of bismuth. On the second day he is allowed sterile water and on the third day broths without milk. Old patients are given a bed rest on the second day and are allowed to get out of bed on the third. At the end of a week the physician passes a No. 48 English bougie every second or third day and then the patient is taught to pass the bougie for himself; at first once a day for a month, then twice a week for a month and finally once a week for another month. How long the bougie will have to be passed by the patient I do not know. I have the feeling that its use can be dispensed with after six weeks. This point will have to be settled in the future. Should it prove necessary to pass the bougie indefinitely this will, of course, be a drawback to the operation. When this point is settled I will report on it.

What happens to the pouch after cutting the common wall? Does the pouch shrink? I have had the opportunity to X-ray but one of the three cases after operation. What I want, of course, is an ether examination on these operated cases, but even a cocaine examination would not appeal to my first case a banker of a Massachusetts city. All that I can say is that the clinical symptoms have disappeared in all the cases and from not being able to pass any bougie at all before the operation each patient now passes on himself a No. 48 English. The opportunity will come sometime to pass a tube on such operated cases. One case, however, was X-rayed ten months after the operation and some inferences can be drawn from the plates taken before and after operation. The second plate shows that the pouch has grown a little

larger at the top and that the stream of bismuth leaving it is about twice as large. I had made up my mind that the pouch would shrink and was much disappointed on seeing the plate, but on thinking it over I found that the clinical result could be explained without the pouch shrinking. All that had been done to the pouch was to slit the common wall; its other walls were not touched. Therefore the pouch did not shrink. However, the slit must have remained open, otherwise the symptoms would have returned and the passage of the large bougie would be impossible. When the patient swallows, the pouch fills with bismuth. This coats its sides and gives a shadow the same as before operation but the pouch which had been operated on immediately empties itself into the œsophagus. This is as far as I can go with my present knowledge. The cutting simply lowers the pharynx, but does not change the side walls of pouch.

CLINICAL CASES

I have already given the symptoms of webs and pouches of the œsophagus and shall make these histories mere skeletons. I have had seven webs and perhaps ten pouches. Not a large number I am sorry to say. The patients are now scattered and I quote largely from memory. The salient points, however, are still fresh in my mind.

WEBS OF THE ŒSOPHAGUS

CASE 1. The patient was a woman about 45 years of age, and was a housekeeper for a Harvard professor. For five years she could not sit through a meal without leaving the table once or twice to spit up food which had accumulated in her throat. She was reduced to a liquid diet and was New England thin. Examination showed a membranous web extending the whole circumference of the upper part of the œsophagus, with a small central opening. The web was disposed of by placing an œsophageal dilator through the perforation, spreading the dilator, and withdrawing it open, thus divulsing the web. The woman at once regained normal swallowing (Fig. 3, 2).

CASE 2. This patient was a woman of the same type but a little younger, 30 years of age. Six years ago she had typhoid fever, and after this developed difficulty in swallowing which increased until for the two years before the examination she could eat only liquids. To my surprise, examination with the fluoroscope gave only a slight delay in swallowing at the lower end of the œsophagus. The X-ray plates showed nothing further (Fig. 4). On examination with the œsophagoscope, however, a large web extending from right to left was found at the upper end of the œsophagus behind the cricoid cartilage. This was cut and the tube forced through it only to find a smaller web a short distance below the first one. The second web was on the left. This was split by forcing the tube end by it. Below the second stricture and at the level of the bottom of the cricoid cartilage there was a third and smaller cresentic web springing from the right side of the œsophagus. This like the second was slit with the pressure of the end of the tube. The patient regained normal swallowing at the end of four days. The three partial webs in this case were much like the successive crescentic strictures which are found in some corrosive strictures of the œsophagus in children. The important point in the case is the fact that the fluoroscope and the X-ray showed no abnormality in swallowing. The stricture was so high that the fluoroscope did not detect it. With this point in mind sharper observation in the future may detect some abnormality in similar cases. Once by the web the food passes normally. The clinical symptoms in such cases are of more value and are more reliable than either the fluroscope or the X-ray plate.

CASE 3. This patient was a pitifully thin, anæmic, toothless woman of 54, and a cook. She gave a history of diphtheria when she was 19 years old. For seven years she had had difficulty in swallowing and was living, to use her own language and she ought to know, "on slops." If she took anything acid she "strangled terribly," again her own words (Fig. 2). Examination showed in the upper part of each pyriform fossa and just below the arytenoid cartilage, a small triangular web. These webs probably caught the acid fluid and spilled it into the arytenoid commissure. At the lower level of the cricoid cartilage there was an annular scar tissue stricture with a central perforation about a quarter of an inch in either diameter. The stricture was dealt with first. It was dilated with the œsophageal dilator without making much progress. Then the tube end was pressed firmly against the margins of the stricture until finally the right edge gave way in a linear tear. The tube was forced on and the lower part of the stricture pressed in on either side of the tube as a crescentic fold. These folds were cut with the scissor punch, and the tube then passed into the œsophagus beyond. The short tube was replaced by a full length tube which passed easily into the stomach. Each of the webs below the arytenoid was then cut using the short tube. In this case the fluoroscope showed no abnormality of the upper end of the œsophagus although I warned the operator to look for it. The fluoroscope showed only little delay at the lower end of the œsophagus. There was probably a slight stricture at this point but the tube easily dilated and passed it. This case is of further interest as showing the presence of symmetrical webs and because of the probable

etiology of the webs; namely diphtheritic ulcerations. Such small webs, are, I imagine, present in many cases of so-called globus hystericus; due, as I said before to some form of trauma or some ulcerative process.

POUCHES OF THE ŒSOPHAGUS

CASE 1. This patient is a patent lawyer about 45 years old. He gave the typical symptoms of a pouch. I saw him three years ago. The X-ray showed a pouch. The examination was carried out in the usual manner. The opening of the œsophagus was dilated and in addition a small cut was made in the common wall. The symptoms were at once relieved. He was taught to pass the bougie on himself and being mechanical he made a short one with a bulbous end which he used at regular intervals for twelve months. At the end of this time he was told to stop using it, none of his symptoms having returned. This was my first attempt at cutting the common wall and I was naturally a bit anxious for the first few days of his convalescence. No unpleasant symptoms resulted.

CASE 2. During the past year I have extensively cut the common wall between the œsophagus and the diverticulum in three cases. The first of the three was a banker sixty years old. The X-ray and the œsophageal examination showed a pouch of moderate size (Fig. 10). The symptoms were of moderate severity, and were of a few years standing. The physician who referred the case could not pass a bougie of any size. One-half of the common wall was cut. Swallowing at once became normal and has remained so for the ten months which have elapsed since the operation. He still passes on himself a No. 48 English bougie twice a week. Once or twice a month if he happens to cough he brings up a flake of food. Beyond this he has no symptoms. A week ago for the purposes of this paper he was X-rayed again. The lower part of the pouch is the same in size as before but the upper portion is a little wider. How long the patient will have to pass his bougie I do not know. Whether the pouch will shrink in time, whether it will enlarge or remain the same and, as now, continue to give no symptoms I must wait to learn. Should symptoms return it should be an easy matter to cut the common wall still more, or to recut it if it eventually glues together (Fig. 12).

CASE 3. The patient who ranks as the third case of cutting is a Canadian farmer and ornithologist. He came to me through a fellow ornithologist of Boston. His symptoms were of moderate severity and had existed for two years. He had a good sized pouch (Fig. 13). Two-thirds of the common wall were cut. This was five months ago. I heard from him a month back and he was free from all symptoms. At that time, four months, after the operation he was told to discontinue the use of the bougie. A week after the operation an attempt was made to take an X-ray, but the bismuth went down so rapidly that the plates showed nothing (Fig. 14).

CASE 4. The patient who furnished the fourth and last case is a retired English army officer, 71 years old. He is a graduate of Oxford, lived well in the days gone by, is a judge of pictures and dogs, and secretary of the Massachusetts Automobile Association. He knows many people and is chairman of the round table at the Boston Art Club. I mention these personal items to show that everything seemed in this case staged for a calamity. Naturally I operated upon him with some foreboding. He first came to me three years ago. This was before I had cut the common wall in any case. The examination showed a large pouch (Fig. 15). The opening of the œsophagus at that time was dilated, and for a few months he swallowed a little better and at first it was possible to pass a good sized bougie. Finally, however, it became impossible to enter or rather to find the mouth of the œsophagus with any kind of an instrument, that is without ether. The only lasting good that I managed to do him came from the fact that I discovered that he could eat better lying on his stomach. For the past two years, therefore, he has taken his food which had to be either liquid or minced, lying on his belly. Six months ago a final attempt was made to pass an instrument into the œsophagus. The attempt failed.

In this case almost the whole of the common wall was cut, only about an eighth of an inch was left intact in order to wall off the mediastinum. It proved to be the largest pouch that I have had, as it reached a little below the lower border of the inner end of the clavicles. If it had not been for the operating window plug which was used for the first time in this case I doubt whether I could have dealt successfully with so much of the common wall, because after the first inch had been cut the œsophageal wall and the wall of the pouch separated, and as soon as the air pressure was discontinued everything folded together and I could not tell where to make the next incision. The operating window plug, however, distended both parts of the common wall and kept them in full view until the bottom of the pouch was reached. The operating window plug proved to be a great advantage over the former plug which allowed only intermittent ballooning. The bottom of the pouch in this case was ribbed with white scar tissue so that the pouch could not be inverted as in the other cases.

On the third day Mr. F. had his first bowl of soup. The day before he was given sterile water which he swallowed normally. This soup, therefore, was his first real meal and I sat by and watched him eat it. He began eating with a spoon and had no trouble. I could stand it no longer and told him to drink it down. He took the bowl in both hands and drank greedily until he had emptied it. For the first time in six years he ate upright like a man. His joy was unbounded. The next day he had a chop for lunch and beefsteak and vegetables for dinner.

SUMMARY

Webs of the œsophagus may follow trauma or any disease which causes ulceration. The web may be an insignificant fold attended by indifferent or slight symptoms or it may be large enough to give severe obstruction in swallowing. Webs of the œsophagus occur behind the cricoid cartilage and neither the fluoroscope nor the X-ray plate shows their presence.

Webs are best treated by cutting, aided if necessary, by divulsion with the end of the œsophagoscope.

Three cases of cutting the common wall of an œsophageal pouch have shown that—

1. The procedure is easily accomplished.
2. It is probably safe.
3. It results in a clinical cure.

The actual fate of the pouch after cutting is not yet established. A sufficient slit to maintain normal swallowing is readily kept open by the passing of bougies. It is still to be settled how long the patient must pass the bougie.

The best method of diagnosing webs and pouches is under general anæsthesia and by the aid of a large oval ballooning œsophagoscope.

Cutting the common wall in a large œsophageal pouch is only practical under the constant ballooning made possible by the operating window plug.

It if should prove that the slit in the common wall made by the knife or the scissor punch should in time reunite it would be worth while to try dividing the common wall with the cautery. Should the common wall reunite it is a simple matter to again divide it.

SURGICAL TREATMENT OF BANTI'S DISEASE

Report of Three Cases[1]

By CHARLES D. LOCKWOOD, M.D., F.A.C.S., Pasadena, California

SURGERY of the spleen has received a great impetus in the past five years and a sufficient number of splenectomies have now been performed to establish a fairly secure basis for determining the indications and value of the procedure. My contribution is based upon a careful review of the literature and personal observation in three cases of Banti's disease, splenectomized and herewith reported.

Dr. G. B. Johnstone, in an exhaustive résumé of this subject in 1908, reviewed all cases of splenic anæmia, 61 in all, treated by splenectomy up to that time. Of that number, 49 recovered and 12 died, a mortality of 19.5 per cent. I have endeavored to collect all cases reported since 1908 and I add three cases of my own, all of which recovered. Observation of my own cases and a study of those reported in the literature of the past few years, leads me to believe that the term "splenic anæmia" best designates the various phenomena accompanying this disease, and as suggested by Rodman and Willard, three stages may be recognized.

The first stage, often extending over a long period of years, is characterized by splenomegaly, anæmia, gastro-intestinal hæmorrhages and pigmentation of the skin. The second stage, of short duration, gives only the added symptoms of renal insufficiency. In the third or terminal stage, the dominant feature of the disease is the failure of liver function with marked ascites and extreme emaciation. The symptom-complex described by Banti, applies especially to the ascitic stage of the disease. Two of my cases fall in the third stage of the disease; one belongs in the second stage. All three cases showed greatly enlarged spleens, anæmia of the secondary type, leucopænia and pigmentation of the skin. There was no etiological factor common to all three cases. All denied syphilis, although one case gave a positive blood Wassermann.

Operative Technique

A long left rectus incision was found entirely satisfactory for the removal of the three spleens, although two of them were very large and many adhesions were encountered. After the adhesions were separated, the spleen was quickly delivered from the abdomen by encircling it with the forearm and elbow, much as one would pick up a large watermelon with one arm. Much time may be lost by futile attempts to deliver a large spleen by grasping the edge with the fingers or instruments. Attention has been called by Dr. W. J. Mayo to the importance of ligating the splenic artery before constricting the veins. Much blood is thereby saved the patient. In my second case, a huge spleen, the vessels were clamped simultaneously and the spleen removed before ligation was attempted. The organ was very vascular and contained a large amount of blood. Fortunately it was thrown into a large sterile basin. When the clamp was removed from the vessels attached to the spleen, about a litre of blood escaped into the basin. Dr. Harlan Shoemaker, who was watching the operation, suggested that the blood lost from the spleen be reintroduced into the patient's veins. I promptly acceded and within ten minutes 750 centimeters of the patient's own blood was filtered, citrated and reintroduced into his veins. This procedure of autotransfusion was thought to be original, but I have found that Lichtenstein reported eight cases of ruptured extra-uterine pregnancy and one of rupture of the uterus, in which blood was scooped out of the abdomen, defibrinated, diluted with salt solution, and reintroduced into the patient with brilliant results. In both my cases, autotransfusion proved of striking value.

Case 1. M. R., male, age 27; Caucasian; occupation, brakeman. Chief complaint: weakness, anorexia, dull, heavy sensation in abdomen, bleeding from the bowels, vertigo at times. In Septem-

[1] Read before the Western Surgical Association, St. Paul, December, 1916.

ber, 1912, when apparently in perfect health, the patient said his bowels filled with blood and he passed a large amount of black, tarry, foul-smelling material from his bowels. This was accompanied by deep, heavy pain in the lower abdomen. From this time until December, 1915, he was able to do only light work. He tired easily and had constant heavy feeling in his lower abdomen. One week before entering the hospital, he had another severe hæmorrhage from the bowels, accompanied by sharp pain in the abdomen. He also spat some blood at this time. Family history: negative, no serious illness, denied venereal disease. Habits: drinks an occasional glass of beer, smokes tobacco. Physical examination: thin, anæmic young man. Head negative, except for pyorrhœa and decayed teeth. Chest negative except for pulsation of the vessels of the neck. Abdomen: liver slightly enlarged, symmetrical abdominal distension. Fluid in the peritoneal cavity. Splenic tumor extending two fingers' breadth below the umbilicus. Genitalia and extremities negative. Reflexes normal. Wassermann positive.

Blood examination, December 14, 1915: hæmoglobin 43 per cent (Tallquist): color index, 8. Erythrocytes, cmm., 2,480,000; leucocytes, cmm., 6,800. Hæmoglobin, 25 per cent (von Fleischl); color index, 6. Erythrocytes, cmm., 2,100,000; leucocytes, cmm., 11,800. Polymorphonuclears, 80 per cent; lymphocytes, 14 per cent; large mononuclears, 4 per cent; eosinophils, 2 per cent; size variable; macrocytes positive; microcytes positive;

Operation, January 4, 1916. Splenectomy and omentopexy were performed through the left rectus incision. The abdomen contained a large amount of straw-colored fluid. During the closure of the incision, one quart of normal salt solution was given under the breast.

Postoperative history. Prompt recovery from operation, with temporary improvement in general condition and then gradual failure. There was no return of hæmorrhage. January 10, 1916, six days after the operation, the blood picture was as follows:

Erythrocytes per cmm., 3,100,000; leucocytes per cmm., 27,200; differential count stain, Wright method, air; polymorphonuclears 41 per cent; lymphocytes 24 per cent; large mononuclears 33 per cent; poikilocytosis absent; size 5-14; macrocytes positive, few. Remarks: coaguability increased, color red cells pale.

January 16, 1916, twelve days after operation:

Hæmoglobin 60 per cent estimated, color index 1.2; erythrocytes per cmm., 3,150,000; leucocytes per cmm., 24,000; differential count; polymorphonuclears 64 per cent; lymphocytes 5 per cent; large mononuclears 18 per cent; eosinophiles 4 per cent; poikilocytosis none; macrocytes positive.

January 24, 1916, three weeks after operation: leucocytes per cmm., 13,400.

When patient was last seen in October, 1916, he was extremely emaciated and had marked ascites. He was being tapped twice weekly and as much as three or four gallons of fluid withdrawn.

Laboratory record. The spleen measured 5 by 15 by 24 centimeters. Microscopic examination: increased connective-tissue stroma, many young leucocytes in the vessel spaces.

Pathologic diagnosis: hypertrophied and engorged spleen.

CASE 2. John S., age 31. Principal complaint was weakness, periodic headache, alternating diarrhœa, dyspnœa, epistaxis, and occasional jaundice. Previous diseases: malaria, at 13 years of age, measles and chicken pox, gonorrhœa; denies syphilis. Habits steady. Moderate drinker, smokes and chews tobacco. Has no drug habit. Physical examination: well-nourished, subicteric tinge to the skin; mucous membranes pale. Abdomen distended, epigastric tenderness; the liver extended two fingers below the costal margin. Splenic tumor reached almost to the brim of the pelvis. Examination otherwise negative. Wassermann on the blood, negative.

Blood picture before the operation: erythrocytes per cmm., 3,100,000; leucocytes per cmm., 6,400; hæmoglobin 80 per cent; differential count 200 cells; small mononuclear 30 per cent; large mononuclear 9 per cent; indentate neucleus 3½ per cent; polymorphonuclear (neotrophiles) 5 per cent; polymorphonuclear (eosinophiles) 2½ per cent; urine normal.

Operation, April 16, 1916, Splenectomy and omentopexy. Intravenous infusion of 750 cubic centimeters of citrated blood recovered from the spleen. Pathologic examination of the spleen: gross examination of the spleen about five times normal size. Smears taken. Microscopic examination: Smears show many small mononuclears, leucocytes and a few polymorphonuclear cells, also eosinophiles. Sections: the capsule is thickened, malpighian corpuscles are on an average a little larger than normal, the trabeculæ are normal and the spleen pulp is replaced in many areas by connective tissue. Dimensions 8 by 14 by 22 centimeters; weight 2 pounds, 11½ ounces.

Postoperative history. The patient made an excellent operative recovery, but complained of much abdominal distress and for a time grew weaker. He then gradually improved and left the hospital much stronger. He has continued to improve with slight remissions. He is now able to do light work.

Blood picture, June 12, 1916: hæmoglobin 65 per cent; color index 1; erythrocytes, per cmm., 3,030,000; leucocytes per cmm., 16,800: polymorphonuclears 66 per cent; lymphocytes 20 per cent; large mononuclears 11 per cent; eosinophiles 3 per cent; poikilocytosis not marked; nucleation none; size, some irregularity; polychromatophilia present.

Both of these cases are, I believe, true cases of splenic anæmia, in the third stage of the disease with the symptom-complex of Banti.

CASE 3. M. S., male, age 47. Russian, occupation motorman. Admitted December 30, 1915. Complaint, pain in the abdomen, headache, loss of appetite, pain in the back and legs. Six months before entering the hospital, he began to feel drowsy, had headache, poor appetite, pain in the legs and numbness. In about three months he gave up work because of weakness. He began to have chills, with high temperature, up to 105°, and night sweats. Patient became jaundiced. October 8, he went to the Crocker Street Hospital. He was given mercurial inunction and potassium iodide in large doses, and improved, his temperature returning to normal. The trouble recurred in about a month. He was again treated with mercury and potassium iodide and recovered sufficiently to go to work. The next time he did not improve by the treatment with mercury.

Previous illnesses. Measles. Denies venereal diseases. Family history negative. Habits, alcohol moderately. Physical examination: slight jaundice, heart sounds, faint systolic murmur over the apex and tricuspid areas, liver extends two fingers' breadth below the costal arch. Spleen greatly enlarged. Abdomen seems distended and tympanitic. Stomach examination: test meal negative. Fæces, negative, no blood. Wassermann, negative.

January 11, 1916, exploratory operation. Cultures made from the blood aspirated from the liver and spleen showed no growth. The surface of the liver was smooth.

Urine: albumin, a trace, a few granular casts.

Blood examination, February 24, 1916: erythrocytes, per cmm., 3,360,000; leucocytes, per cmm., 9,200; polymorphonuclears 40 per cent; small mononuclears 46 per cent; mononuclears 11 per cent.

Blood examination, September 25, 1916: hæmoglobin 50 per cent; color index 85 per cent; erythrocytes, per cmm., 2,940,000; leucocytes, per cmm., 22,200; polymorphonuclears 39 per cent; large mononuclears 2 per cent; small mononuclears 50 per cent; size irregular; poikilocytosis well marked; macrocytes present.

October 5, 1916, splenectomy. Five hundred centimeters of blood expressed from the spleen after removal was citrated and reintroduced into the patient's veins. He stood the operation well.

Postoperative history. Patient healed primarily but ran a high temperature for several days after the operation. He then began to improve, temperature returning to normal, and he remained better for a week or two, when he had a relapse with high temperature, loss of appetite and weakness. These relapses have occurred periodically up to the present time. Following attacks of fever, the patient will have diarrhœa for a day or two and temperature returns to normal.

Blood examination, October 24, 1916: hæmoglobin 60 per cent; leucocytes, per cmm. 33,000.

Blood examination, November 10, 1916: hæmaglobin 60 per cent; erythrocytes, per cmm. 3,160,000; leucocytes per cmm. 33,700; polymorphonuclears 14 per cent; large mononuclears, 42 per cent; small mononuclears 35 per cent; eosinophils 1 per cent.

This case was variously diagnosed as Hanot's cirrhosis, chronic leukæmia, splenic anæmia, and pyroplasmosis. The presence of a large spleen, a secondary anæmia, with slight jaundice and a leucopænia, except during a period of fever, justify the diagnosis of splenic anæmia. Recent urinalysis and functional kidney tests show very poor elimination and a marked albuminuria. Phthalein failed to appear in the urine of the left ureter at the end of 30 minutes. It appeared in the catheterized specimen from the right side in ten minutes. Total output in 30 minutes was only 7½ per cent. This failure of kidney function at times approaches complete suppression, accompanied by high fever and diarrhœa. It is characteristic of the second stage of splenic anæmia.

Blood count November 23, 1916: erythrocytes 3,430,000; leucocytes 42,500.

I have collected 38 cases from the literature, and three cases of my own make 41 in all. Of this number, six died as a result of operation, making an operative mortality of 14.5 per cent. The operative mortality prior to 1908 in 61 cases was 19.5 per cent. No doubt there have been many cases which have not been reported and there are many more in foreign journals which I have been unable to secure, but the cases herewith reported are representative of the surgical results in this disease.

Operation done in the first stage of the disease is curative in a large percentage of cases and the operative mortality is no higher than in other major abdominal operations. In the second and third stages of the disease, there is still a large percentage of recoveries with great improvement of health. Our views regarding splenic anæmia will no doubt change from time to time as our knowledge regarding the normal physiology and pathologic changes in the spleen become more exact. Our experience thus far in splenectomy for Banti's disease would seem to justify the conclusion that overfunctioning of the spleen, whether of toxic or bacterial origin, is the cause of the anæmia and liver changes so characteristic of the disease. The most striking lessson taught by my cases was the great distensibility of the spleen and the importance of saving to the patient, either by preliminary ligation or by autotransfusion,

the large amount of blood contained in the organ.

CASES REPORTED IN LITERATURE SINCE 1908

1. AMBROSE, THEO., Austral. M. Gaz., Feb. 22, 1913. Male age 26, no tuberculosis, syphilis or malaria. Large abdominal tumor on left side. Liver two fingers below costal arch, secondary anæmia. Splenectomy, tail of pancreas tied off in operation. Postoperative: symptoms of intestinal obstruction, temperature 104° daily for several weeks ascribed to injury of the spleen. Good recovery, blood picture returned to normal.

2. BLAKE, J. B., Ann. Surg., Phila., Sept., 1915. Child 2½ years old. Family history negative. Child weak and pale. Painful micturition and defæcation, large spleen, filling half of the abdomen. Blood: hæmoglobin 45 per cent, white blood corpuscles 6,600; red blood corpuscles 2,496,000. Splenectomy, complete recovery.

3. CLARK, E. D. (5) Female age 25, primary splenic anæmia. Splenectomy March 1912. Large amount of blood lost in the spleen at the time of operation, enough to blanch the skin. 1,000 centimeters normal salt solution intravenously, recovery. Great improvement, patient alive in 1916.

4. FOWLER, R. S. Am. J. Surg., 1914, July, 2 cases.
Case 1. Child, male, age 5½. Abdominal cramps, fever, nose bleed, enlarged spleen and liver, moderate anæmia. Wassermann negative. Splenectomy, complete recovery.
Case 2. N. Y. St. M. J., Sept. 1914. Child, female. Fourteen months old. Moderate anæmia, spleen enlarged six times natural size. Splenectomy, complete recovery.

5. GROVES, E. H., Bristol M. J. 1913, xxxi, No. 122. Advanced case with cirrhosis and ascites. Recovery after splenectomy.

6. GIFFIN. Ann. Surg., Phila., Dec. 1915, Female age 2½ years. Splenectomy by Balfour, recovery, improvement.

7. HARE, DOROTHY C. Female, age 45, no hæmorrhages, recovery.

8. HITZROT. Ann. Surg., Phila., Sept., 1914. Male age 30 years. Malaria at 14, jaundice for three months, splenectomy, recovery.

9. HERRICK, F. C. Ann. Surg., Phila., May 1914. Female, Polish, aged 33. Married. No chronic diseases. Weakness, jaundice, slight anæmia, pigmentation of the skin. Splenectomy in July 1913. Recovery.

10. HUTCHINSON, J. Excision of spleen for splenic anæmia. Proc. Royal Soc. Med., vi, No. 8, Surg. Sec. p. 236. Boy seven years of age, large spleen, emaciated, anæmic. Splenectomy, cured.

11. HARRIS, W. L. Providence M. J. January 1908. Female age 34. Tuberculosis of the lungs with hæmorrhages. Splenectomy. Recovery, great improvement.

12. KIDD, FRANK. Proc. Royal Soc., Surg. Sec., viii. No. 8, p. 225. Girl seventeen years of age. Ascites, hæmatemesis. Splenectomy, complete recovery.

13. LACOUTRE (4). Female age 39. Died 27 days after the operation.

14. LISSNER, H. H. Cal. St. M. J., Sept. 1915. Male, age 25. No tuberculosis, malaria, but no other chronic disease. Spleen enlarged since childhood. Principal symptoms: jaundice, ascites, itching of the skin. Spleen reached to the level of the umbilicus. Patient tapped twice before operation. Blood picture: hæmoglobin 30 per cent., white blood corpuscles 12,000, red blood corpuscles 3,000,000. Operation February 12, 1914, by Dr. Edelman. After operation ascites disappeared, blood returned to almost normal. Patient able to work.

15. MACDONALD (6). Chinese boy, age 16. Splenectomy, recovery.

16. MEYER, WILLY. Ann. Surg., Phila., xlix, 258. Operated March 23, 1908. Recovery, improved.

17. MAYO CLINIC. Twelve cases compiled by H. Z. Giffin, Mayo papers, 1912. Two deaths.

18. POOLE, E. H. Ann. Surg., Phila., Dec. 1914. Female, age 39. Bloody vomitus, dark stools, enlarged spleen. Blood: hæmoglobin 28 per cent; red blood corpuscles 1,600,000. Pre-operative transfusion with hæmolysis and vomiting of blood. Second transfusion, 700 centimeters of blood. Splenectomy, recovery.

19. PRINCE, E. M. Alabama M. J., April 1910. Male age 26. Protracted attacks of malaria, large abdominal tumor. Splenectomy, stormy convalescence, perfect recovery, health normal eight months after operation.

20. RAMEY, R. L. Tex. St. J., Sept. 1914. Male age 31. Porter. No specific disease. Symptoms: dismenia, enlarged abdomen, moderate anæmia, no leucocytosis, ascites. Died nine days after operation. Developed some ascites after operation. Postmortem, atrophic cirrhosis of the liver.

21. RODMAN and WILLARD (2). Report two cases.
Case 1. Young male, operated upon by Dr. Guthrie, splenic anæmia in second stage three years' duration. Splenectomy, patient died of gradual oozing from stomach and intestine.
Case 2. Female, age 18, splenic anæmia. First stage. Splenectomy. Recovery with pleural effusion and pus in the lower abdomen.

22. SCHUPPER, F. Gaz. deg. osp., Jan. 19, 1908. Male age 4. Splenectomy, hypercythæmia after operation. Recovery.

23. SCUDDER (7). Male age 18, Russian. No previous infections. Chief symptoms bleeding from nose and mouth. Splenectomy. Postoperative thrombosis of mesenteric vein. Gangrene of the small intestine. Resection, death.

24. SOMERS, J. E. (3). Thrombosis of splenic vein. Severe shock postoperative. Large collection of pus in lower abdomen, fæcal fistula, final recovery.

25. STURGIS, M. G. Boston M. & S. J., May 24, 1914. Male age 18. Hæmatemesis, some chronic infection, moderate anæmia. Splenectomy. The patient had previously had an operation for infected gunshot wounds. Splenic enlargement followed one year after. Fair recovery.

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3. SOMERS, J. E. Thrombosis of the spleen. Ann. Surg., Phila., 1908, June.
4. LA COUTURE. J. de méd. de Bordeaux, 1913, Dec. 14.
5. CLARK, E. D. Am. J. Obst., N. Y., 1916, Feb.
6. MACDONALD, G. C. Pacific M. J., 1909, Nov.
7. SCUDDER. Ann. Surg., Phila., 1915, Nov.

GANGRENOUS CHOLECYSTITIS

With Report of a Case Due to the Gas Bacillus

By GILBERT GEOFFREY COTTAM, M.D., F.A.C.S., Sioux Falls, South Dakota

MRS. F. B., aged 41, farmer's wife, living near Harrisburg, South Dakota, mother of six children, the youngest 8 years old. No especial difficulty with any of her labors or puerperia and free from history of severe illness except typhoid ten years ago and measles six years ago. I saw her first on March 8, 1916, in consultation with Dr. Herbert Day, obtaining the following history of her present illness:

Two days previously, in the forenoon, she had felt as well as usual, but after working unusually hard all morning had felt pain through the lower part of her chest and later in the day in the upper abdomen, particularly in the midline, accompanied by vomiting. Dr. Day saw her for the first time that evening, finding the whole abdomen tender, pressure producing epigastric pain. Rigidity absent. Pulse 72, temperature 98.4° F.

On the following day, March 7, she complained of the most pain about the navel and in the right lower quadrant and Dr. Day found extreme tenderness over McBurney's point, with marked rigidity, some tenderness and slight rigidity in the gall-bladder region, and general tympanites. Pressure over the lower descending colon produced intense pain in the right lower quadrant. Pulse 80, temperature 99.4° F.

The diagnosis at that time appeared to lie between cholecystitis and appendicitis, possibly both. The patient had not menstruated since January 15, 1916, and was supposed to be pregnant between one and two months.

On the next day, March 8, when I first saw her, the symptoms had again shifted to the upper abdomen with exquisite tenderness and rigidity in the right hypochondrium, and there could be made out by deep palpation a globular mass which seemingly could only be the gall-bladder tightly distended. The pulse was then 112, temperature 100° F. Diagnosis acute cholecystitis of an unusually virulent type.

She was removed that afternoon to the McKennan Hospital, Sioux Falls, where a blood examination showed the following: reds, 4,824,000; whites, 13,300; hæmoglobin, 85 per cent; polymorphonuclears, 79 per cent; lymphocytes, 12 per cent; mononuclears, 8 per cent; transitionals, 1 per cent. The urinalysis was as follows: color, dark straw, cloudy; specific gravity, 1.030; reaction, acid; sugar, negative; albumin, positive, 1.75 grams per liter; sediment, many pus and epithelial cells, finely granular casts, urates and phosphates, colon bacilli.

Pulse 88, temperature 100° F. Later on the pulse was 85, temperature 100.2° F., suggesting superficially some abatement of the severity of the infection, but the local symptoms remained unchanged and she spent a bad night and was no better the following morning, when I operated through a straight right rectus incision. I exposed the gall-bladder, finding it buried in adherent omentum and large intestine, but the adhesions were recent and easily released. The gall-bladder was tightly distended and of a deep red color. Near the fundus was a greenish, blistery, gangrenous oval area, 1.5 centimeters in the short and 2.2 centimeters in the long diameter, and a short distance back a smaller area of similar appearance (Fig. 2, frontispiece). The omentum, which had been adherent, also showed a yellowish-green slough at the point of contact. Aspiration of the gall-bladder yielded dark greenish bile with no visible evidence of pus. There were five small stones, about the size of grains of wheat. A small stone is seen near the duct end in Fig. 1, frontispiece.

I then proceeded to remove the gall-bladder, beginning at the fundus, and immediately found the entire portion in juxtaposition to the liver gangrenous. I dissected it loose from the liver back to the cystic duct, which I divided between forceps and ligated at the proximal end, not without difficulty on account of the friability of the duct, which kept tearing away from the forceps all the time bleeding freely from the cystic artery until tied. The gall-bladder removed, I stitched together the edges of the peritoneum over its former bed and anchored a wrapped drainage tube down to the stump of the cysticus and leading out of the abdominal incision.

Recovery was unaccompanied by incident, except the sudden termination of the pregnancy on the sixth day after the operation.

The bacteriological examination of the excised gall-bladder brought forth findings of the greatest scientific interest, and I take this opportunity of commending the painstaking work of my laboratory assistant, Mr. Charles A. Northrop, in this connection.

Bacteriological report on gangrenous gall-bladder removed from Mrs. F. B., March 9, 1916.

1. Smear from gangrenous area showed the presence of a large plump bacillus.

2. Culture started from above in bouillon. Eighteen hours later stained specimens prepared and sub-cultures made in bouillon, agar-agar slant, lactose broth (fermentation tubes) and glucose-litmus-agar plate.

Morphology. Stained specimen of culture showed a mixed growth of staphylococci and a

moderately long, plump bacillus with rounded ends, occurring singly, in pairs and very often in long chains.

Cultural features. (1) Moderate clouding, (2) odor not noticeable, (3) abundant flocculent sediment, (4) evidence of gas by frequent bubbles coming to the surface.

Examination by hanging drop showed non-motility.

3. Examination of sub-cultures in 2.

Morphology. Stained specimens showed a strongly mixed growth of staphylococci and the bacillus as found in the original culture.

Cultural features. (1) Agar-agar (slant) — growth moderate, beaded, raised, white; (2) glucose-agar (slant) — growth abundant, widely spread, gas bubbles numerous; (3) broth — similar to original culture.

After twenty-four hours sub-cultures for anaerobic growth were made in broth, glucose-agar (stab and slant) and agar-agar. These were placed in a Novy jar which contained 10 grams of pyrogallic acid and 100 cubic centimeters of a 1 per cent solution of NaOH per liter of capacity. Jar sealed tightly and incubated for twenty-four hours.

4. Examination of anaerobic sub-cultures in 3 and second anaerobic sub-cultures started.

Stained specimens showed a preponderance of the plump, rounded-end bacillus, appearing less frequently in chains. Stained well with all aniline stains. Gram positive and capsular stain positive.

Cultural features. (1) Agar (slant) — small white colonies, growth not abundant; (2) glucose-agar (slant) — growth abundant, more than on plain agar, but appearance the same; (3) glucose-agar (stab) — gas bubbles showing throughout media; (4) broth — growth abundant, cloudy sediment, same as previous cultures. Hanging drop examination showed non-motility.

5. Examination of second anaerobic sub-cultures at the end of twenty-four hours resulted as follows:

No change in appearance of organisms: possibly the length average shorter than heretofore. Growth of cultures compared similarly to previous growths except a scanty growth was found on plain agar.

6. Sub-cultures made in milk and litmus-milk and incubated aerobically, with the following results at the end of twenty-four hours:

(*a*) Acid reaction in litmus-milk. (*b*) Gas bubbles forming. (*c*) Digestion seemingly slow.

7. Anaerobic milk sub-cultures started with the following results:

(*a*) Reaction same as aerobic cultures. (*b*) Precipitation of casein without digestion.

Twenty-four hours later casein completely curdled.

8. Male guinea pig of average weight inoculated with 0.5 cubic centimeters broth culture of twenty-four hours growth. Injection made in peritoneum. At the end of seventy-two hours no apparent change in condition. Another injection of 0.5 cubic centimeter twenty-four hour milk culture given in muscles of abdominal wall. Pig died about eighty hours after second injection. Abdominal walls gangrenous and œdematous. Smears and cultures taken from blood of heart, fluid of abdominal wall, scrapings of stomach wall and liver.

Smear 1. Fluid from abdominal wall. Many bacteria found of the characteristic form. Occurrence in pairs and single. Marked number of spores noticed.

Smear 2. Stomach. Bacteria larger, occurrence single in pairs and in chains. No spores.

Smear 3. Blood from heart. Similar to Smear 2.

Smear 4. Liver. Few present. Twenty-four hours later all the cultures showed a moderate growth. Specimens prepared from all and stained with methylene blue, capsular stain, spore stain and Gram's. The characteristic bacilli were found in all.

Bacteriological conclusions. The morphological and cultural findings indicate conclusively that the organism is the bacillus aerogenes capsulatus.

In summing up the features of interest in this case, I would emphasize especially the fact that while gangrene of the gall-bladder of ordinary bacterial causation is uncommon, W. J. and C. H. Mayo having seen but one case in 433 operations on the gall-bladder and ducts and John B. Deaver only two in 328 operations on the biliary tract,[1] gangrene of the gall-bladder due to gas bacillus infection seems to have hitherto escaped observation, no mention of any case of the kind in literature occurring, so far as I have been able to discover. There is no apparent reason why it should not occur oftener, with the gas bacillus a normal inhabitant of the intestinal tract, but the fact remains that hitherto it has been unknown as a causative factor in gangrenous cholecystitis. Why it should have been concerned in the present instance, I do not know. One thing is certain, the gas bacillus is here to be reckoned with in South Dakota, as in other parts of the world, this being the fifth case in three years in which the micro-organism has been recognized in my own experience alone, and while it is true that it is most commonly associated with crushing injuries of the extremities, it occurs occasionally in traumatism of the trunk and the present instance shows its ability to start an acute infective process even without a predisposing injury. It is especially imperative that we recognize and be prepared to deal with this form of infection, no matter where it attacks the body, since it is unquestionably one of the

[1] Deaver and Ashhurst. Surgery of the Upper Abdomen, vol. ii, 59.

most virulent and uncompromising of which we have any knowledge. The inoculation period is about forty-eight hours[1] and the death rate estimated at about 50 per cent.[2] Hewitt agreeing with Blake and Lahey[3] is of the opinion that recovery is rare after the third day of the development of the infection.

[1] Hewitt. J. Am. M. Ass., lvi, 959.
[2] J. Clark Stewart. J. Am. M. Ass., xlv, 531.
[3] J. Am. M. Ass., liv, 1671.

THE ABUSE OF CÆSAREAN SECTION[1]

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TO my way of thinking, one of the chief advantages of such gatherings as the Clinical Congress is the opportunity they afford for the standardization of surgical thought and practice, thereby enabling one to establish a rational mean between the extreme views of the enthusiast and of the ultraconservative.

Unfortunately, history shows that advances in the practice of medicine and surgery are rarely attained in a thoroughly rational manner, but that a period of undue enthusiasm, or even of almost reckless abuse, usually precedes the establishment of the actual value of a given procedure.

From my personal experience and reading, as well as from my intercourse with other medical men, I believe that we are at present going through such a stage in connection with cæsarean section, and I propose to utilize the short time at my disposal in giving my reasons for this conviction. Generally speaking, I consider that the operation is being abused in two ways: first, that it is frequently employed unnecessarily; and secondly, that, even when strictly indicated, it is not always performed at the time of election, with the result that its mortality becomes needlessly high.

The prime factor concerned in bringing about this abuse is defective medical training, with consequent ignorance of the wonderful adaptability of Nature, and of the resources of obstetrical art. Subsidiary factors are to be found in the technical ease of the operation, and in the glamor which still surrounds it in the professional and lay mind, as well as in an underestimation of its mortality. That the abuse is primarily due to defective obstetrical training will be developed during the course of my remarks, so that for the moment I shall consider only the subsidiary factors.

It must be admitted that conservative cæsarean section is technically a simple operation, which can readily be performed by anyone possessing rudimentary operative ability; and, furthermore, when followed by the complete removal of the uterus, or by its low amputation, it is simpler than the corresponding procedure in the treatment of uterine myomata. Such being the case, cæsarean section would seem to offer an uncomparably easier method of dealing with complicated labor, than more or less expectant treatment with eventual delivery by the unaided efforts of Nature, or after a typical obstetrical procedure. The former requires only a few minutes of time and a modicum of operative experience; while the latter often implies active mental exertion, many hours of patient observation, and frequently very considerable technical dexterity. Thus far the argument seems to be so entirely in favor of cæsarean section that the uninitiated can scarcely be blamed for assuming that there is no justification for protesting against its abuse, or for concluding that the ideal to be striven for should be its greatest possible utilization, so that eventually only two types of obstetrical cases would need to be differentiated; namely,

[1] Read before the Clinical Congress of Surgeons of North America, Philadelphia, October 23-27, 1916.

those ending in easy spontaneous labor or requiring some simple operation, which could be performed by a midwife, and those which bid fair to present a serious complication, which should be promptly ended by the surgeon. Could such a differentiation lead to increased safety for the patient, nothing could be said against it, even though it resulted in the eventual disappearance of the trained obstetrician, the glorification of the midwife, and the exaltation of the skilful but unthinking cutter. It must, however, be admitted that such a conclusion is a *reductio ad absurdum*, and is contrary to the trend of enlightened medical thought.

It is currently believed that the mortality of conservative cæsarean section should not exceed that of other simple abdominal operations, and probably most of those here present, who have not had a large personal experience with the operation, would place it at 2 per cent. Such results, however, are obtainable only under exceptional conditions, and I feel safe in stating that the average mortality throughout the country approaches 10 per cent. In other words, the operation is much more dangerous than is generally believed.

How can this discrepancy be explained? The answer is very simple; namely, that ideal results are obtained only when the operation is performed at an appointed time at the end of pregnancy, or shortly after the onset of labor, upon uninfected women amid suitable surroundings. On the other hand, the mortality of conservative cæsarean section increases with every hour the patient has been in labor, and approaches 10 per cent when performed after the second stage has become well established, and goes still higher when the operation is undertaken upon frankly infected or exhausted women. The truth of this statement has been conclusively established by the studies of Edward Reynolds and Armand Routh, and has been borne out by my own experience. Thus, while the total mortality in my series has been 8 per cent, only a single patient was lost when the operation was done at the time of election.

This rapid increase in mortality is due to intrapartum infection, as is clearly shown by the following considerations. In the first place, my experience has taught me that the convalescence is less satisfactory after the conservative operation than when the uterus has been removed. This becomes more significant when it is remembered that I do the former operation upon uninfected women early in labor while the latter is usually performed late in the second stage upon women who were already infected, or who had been subjected to vaginal examinations by those whose technique was not above reproach. Such observations are analogous to the general experience in the treatment of uterine myomata; the convalescence being much smoother when the entire uterus is amputated than when the tumors are enucleated and the uterus is retained. They point clearly to the conclusion that the involuting uterus offers a lessened resistance to infection, and that a larval infection, which would probably have done little harm had labor terminated spontaneously, may lead to death if it progresses in an incised, involuting uterus.

That this is not a mere theoretical deduction has been clearly shown by the histological study of a series of 45 uteri, which I have amputated at the time of labor. A large fraction of these showed acute inflammation of the decidua, which had clearly originated in the cervical region and was spreading upward, so that in extreme cases the entire interior of the uterus had become involved. The existence of histological evidence of infection was not surprising when the patients presented an elevated temperature before operation, but was very significant when observed in women who were free from fever, and in whom the indication for radical operation was afforded solely by the fact that they had been long in the second stage of labor, or had been frequently examined by persons with questionable technique, before coming into my hands.

As the result of these considerations, I think it fair to conclude that conservative cæsarean section is a safe procedure only when performed early in labor, and that the probability of larval infection makes the late

operation too dangerous to be undertaken except in unusual and exceptional circumstances. Accordingly, I hold that it is *an abuse* to perform conservative cæsarean section after the patient has been long in the second stage of labor, even though she presents no evident signs of infection. Under such conditions it is advisable to attempt to terminate labor by some other procedure; but if cæsarean section is imperatively necessary, it should be followed by amputation of the body of the uterus or by total hysterectomy.

I shall say nothing at this time concerning the employment of the several varieties of extraperitoneal cæsarean section in such circumstances, as I do not feel that we are as yet in a position to make positive statements concerning its merits; but I have no hesitation in stating that the strictly extraperitoneal operation, as advocated by Kuestner and others, is a difficult procedure which should not be undertaken casually.

Thus far I have considered the abuse only in so far as it is concerned with failure to operate at the proper time, and now I shall turn to a much more serious aspect of the subject; namely, laxity in determining the indications for the operation.

In the early days of the modern cæsarean section obstructed labor was almost the only indication—contracted pelvis and clogging of the birth canal by ovarian and uterine tumors. We can all recall the old distinction between the absolute and relative pelvic indication. These were retained for many years, but as the mortality gradually diminished, the upper limit for the absolute indication was extended to pelves presenting a conjugata vera of 7.5 centimeters, provided the child was alive and the mother in good condition. At the same time, the relative indication was so extended as to include any case in which such disproportion existed between the size of the head and the pelvis as to preclude the possibility of spontaneous labor. Naturally, this indication is extremely *variable*, and is dependent upon the size and consistency of the head and the character of the uterine contractions, rather than upon the actual size of the pelvis. Thus, it may happen that one of two women, having pelves of the same size and children presenting identical head measurements, will have an easy spontaneous labor, while the other will require a radical operation. The spontaneous outcome in the former being due to the fact that strong uterine contractions had so molded the malleable head as to adapt it to the contracted superior strait, while in the latter inefficient contractions or a less malleable head rendered such a termination impossible. Consequently, if manifest and serious disproportion does not exist, it is necessary to subject the patient to the test of labor in order to ascertain the outcome. In this event, one waits until the cervix has become fully dilated and then ascertains the effect of several hours of second stage pains. From what I have previously stated, it is evident that if the test of labor fails the time of election for a conservative cæsarean section has passed, and if it is then performed the mortality will have increased to such a point as to make it questionable whether one is justified in exposing the mother to so great a risk for the problematical existence of a newly-born child.

It is therefore apparent that in the presence of the absolute indication the decision to operate is perfectly clear, while it is often extremely difficult in what I have designated as borderline cases, and unfortunately for our peace of mind the latter are much more common. It is in the latter type of pelvic contraction that the greatest abuse of cæsarean section occurs, and I am convinced from my reading, as well as from my consulting work, that many unnecessary operations are performed. Each year I see patients from other cities who have been advised by presumably competent men that cæsarean section is essential to a successful delivery, and yet upon examination I find no evidence of excessive disproportion, and some weeks later I have the satisfaction of seeing the patient delivered spontaneously.

Indeed, I have been reluctantly forced to the conclusion that in many parts of the country the mere diagnosis of a contracted pelvis, irrespective of its degree, is considered

a satisfactory indication for operation. This indicates profound lack of obstetrical knowledge and ignorance of the fact that from 75 to 80 per cent of all women with contracted pelves will be delivered spontaneously if given the opportunity. In other instances, the abuse of the operation can be attributed only to an obsession by the *furor operativus*.

Owing to the unusual incidence of contracted pelvis in the colored women of Baltimore and to the fact that they constitute nearly one-half of the clientele of my service, I have had an unusual opportunity to study the course of labor complicated by this abnormality. Excluding funnel pelves, I see each year 200 to 250 women presenting various degrees of contraction of the superior strait, upon whom I perform 10 to 12 cæsarean sections and one or two pubiotomies. With my present knowledge they are all that I feel justified in doing, and yet if I followed the indications adopted by some of my friends in other cities I should treble or quadruple that number. Naturally, they would contend that I am too conservative, but I should prefer to believe that they are too radical. Possibly, the truth lies between the two extremes; but, even so, it would seem that there must remain a considerable margin for abuse.

Such a degree of conservatism can give ideal results for mother and child only in the hands of those who possess an extensive knowledge of the course of labor in contracted pelves, and who study each patient intensively. It would lead too far afield to describe in detail the methods by which such patients are studied, and here it must suffice to state that I attempt to differentiate between those in whom such a degree of disproportion is present as will certainly preclude the possibility of spontaneous labor, and those in whom it is absent. The former are treated by cæsarean section at the time of election; while the latter are subjected to the test of labor, and are usually delivered spontaneously. In a certain proportion of cases the existence of excessive disproportion is readily established at the first examination, while in a large number its presence or absence can be determined only after repeated examinations at weekly intervals. With increasing experience the prognosis becomes more and more accurate, but I hope that no one will imagine that I wish to claim that one can become infallible; for it occasionally happens, as a result of deficient uterine contractions or of a non-malleable head, that the expected engagement does not occur after the test of labor, and one is then placed in the unpleasant predicament of having to chose between a conservative cæsarean section, after the time of election has passed, and some other expedient. It is in such circumstances that pubiotomy offers the possibility of saving both child and mother at a minimum risk; and it is probable that one of the several varieties of extraperitoneal section may prove to be of still greater availability.

It may reasonably be asked why one might not be a little more liberal with the indications and do a few more sections, instead of subjecting many patients to the test of labor. The answer is threefold: first, that it would lead to an increase in the maternal mortality; second, that it would result in slipshod mental processes, as the performance of any operation in the absence of a clear cut indication is a confession of obstetrical failure; and third, that the presence of the cicatrix in the anterior uterine wall constitutes a *locus minoris resistentiæ*, which may lead to rupture in subsequent pregnancies. Provided the uterine wound has healed by first intention, such a possibility is quite remote, but if convalescence has been disturbed, the cicatrix is frequently so thin that rupture may readily occur. To this extent I subscribe to the dictum: "Once a cæsarean, always a cæsarean."

I have dwelt at some length upon the abuse of cæsarean section in the treatment of contracted pelvis, for the reason that clear cut ideas upon the subject have not yet spread through the profession, and also because the abuse is more subtile than in the conditions which I am about to consider.

Following the advocacy of Lawson Tait, A. P. Dudley, and particularly of Kroenig, cæsarean section has recently come to play a prominent part in the treatment of placenta prævia. Kroenig recommended its employ-

ment from two points of view; first, on account of the appallingly poor results obtained in the Duchy of Baden following purely obstetrical treatment; and, second, from the theoretical consideration that the lower uterine segment, which forms part of the placental site, is so constituted that it is unable to contract satisfactorily, and thus predisposes to further hæmorrhage after the completion of labor. Koenig's suggestion has been followed by many, but thus far the results reported have been inferior to those obtained by less radical procedures, in the hands of masters of the obstetric art.

I am willing to admit that cæsarean section is occasionally the best method of dealing with the condition, more particularly in cases of complete placenta prævia associated with a rigid cervix, and complicated by profuse hæmorrhage. Such a combination, however, is extremely rare, as ordinarily the abnormal placental implantation early leads to softening and partial dilatation of the cervix. Consequently, the best general treatment consists in the introduction of a Champetier de Ribes balloon, which checks the hæmorrhage immediately and leads to complete dilatation of the cervix within a reasonable time, after which delivery is effected by version and extraction.

This recommendation is not based upon theoretical considerations, but is the result of nine years' experience in my service. During that period all cases of placenta prævia, with one exception, which required active interference, were treated by means of the bag, and but one woman was lost. Strange to say, that death occurred in the only patient upon whom I have as yet felt justified in performing cæsarean section for the relief of this complication, but it was in no way connected with the operation, as it was due to a chronic nephritis from which the patient had suffered for years.

As better maternal results could not have been obtained by any other method of treatment, our experience refutes the claims of those who postulate that cæsarean section is essential to a low mortality. Furthermore, the evidence becomes still more convincing when I mention the fact that our patients were treated by a succession of resident obstetricians, as well as by me. Consequently, it cannot be objected that exceptional operative skill is essential to satisfactory results. I am ready to admit that equally good results might follow the employment of cæsarean section by an expert, but I doubt very much whether they could have been obtained by my assistants, and I am sure that they could not had the sections been performed by casual surgeons. Moreover, it must be remembered that a certain proportion of hospital patients have become infected before admission, so that from what has already been said concerning the general mortality of cæsarean section, it is evident that a certain proportion of deaths must inevitably follow had that operation been performed.

In view of my experience, I can see only two arguments in favor of the frequent use of cæsarean section in this condition. The first is that it may save a number of children, which would be lost by the employment of more conservative methods. This must be granted, but when it is remembered that a large proportion of the children are premature, and others are already dead when the case comes into our hands, it must be confessed that the gain will not be very great, and it is questionable whether it is sufficient to counterbalance the greater maternal mortality incident to the operation. The second argument is that delivery by cæsarean section is much more expeditious, and will save the physician both time and mental anxiety. This also is true, but the training of the conscientious obstetrician is such that he lays little stress upon such considerations, and until it has been demonstrated that a distinct lowering of maternal mortality will follow the procedure, I hold that its frequent employment is subversive of sound obstetrical teaching, and represents an unjustifiable concession to the excessive surgical tendencies of the age.

A third abuse of cæsarean section consists in its increasing employment in the treatment of eclampsia. Naturally, even a semi-trained obstetrician would not think of employing it if the cervix were sufficiently dilated to permit delivery by forceps or by

version and extraction, or if the cervical canal were obliterated and the external os sufficiently softened to permit of safe manual dilatation. In this connection, I say semi-trained obstetrician advisedly; as I have recently heard of a surgeon who performed cæsarean section upon an eclamptic multipara whose cervix was more than half dilated.

On the other hand, I hold that the operation is occasionally indicated in primiparous women, who present an unobliterated and rigid cervix and a narrow birth canal, and who show no signs of improvement after copious venesection. In such circumstances, the operation is more conservative than forcible attempts at instrumental or manual dilatation of the cervix, and I have utilized it with great satisfaction upon several occasions. In multiparous eclamptic women, on the contrary, I do not believe that cæsarean section is indicated, no matter what the condition of the cervix, as in such cases the birth canal is sufficiently patulous to make vaginal hysterotomy a feasible procedure. After considerable experience with the latter operation, I consider it, when practicable, greatly superior to abdominal cæsarean section, on account of the simpler and more rapid convalescence and the avoidance of the abdominal and uterine cicatrix.

From my experience, I believe that once in approximately 15 or 20 cases of eclampsia, cæsarean section affords the most conservative method of emptying the uterus; so that what I wish to protest against is not its occasional employment, but the growing tendency on the part of many to regard it as an almost routine measure in the treatment of this disease.

A fourth type of abuse of cæsarean section consists in its employment in the treatment of certain abnormal presentations, such as transverse, breech, face, and brow presentations. Naturally, no objection can be raised against the procedure, if the abnormal presentation is associated with such a degree of pelvic contraction or excessive fœtal development as would give rise to serious disproportion; so that what I am about to say applies only when the operation is performed solely on account of the abnormal presentation. The enormity of the abuse can be best appreciated if each of the several varieties of malposition are briefly reviewed.

No properly trained person would consider for a moment the propriety of performing cæsarean section if the existence of the transverse presentation were diagnosticated sufficiently early to permit of a simple version and extraction. On the other hand, its feasibility is sometimes considered as an alternative to decapitation in neglected cases, in which the child is alive, but the shoulder is so firmly impacted that version is out of the question. It must be admitted that the desire to avoid sacrificing a live child is a laudable one, and should be encouraged, provided it can be effected without too great danger or damage to the mother.

The fact that the patient comes into our hands with an impacted transverse presentation means that she has been neglected by an ignorant doctor or midwife, and in all probability has already been infected by their ministrations. This, of course, precludes the employment of conservative cæsarean section, as the time of election has long since passed, and involves the necessity of total hysterotomy or low amputation of the uterus if a successful outcome is to be obtained.

Consequently, the question to be determined is whether one is justified in doing a Porro cæsarean section in order to avoid decapitating a child, which, while still alive, is already seriously compromised. To my mind, the answer depends upon the social status of the woman, her desire for a living child, and particularly upon whether she is the mother of several children or is pregnant for the first time. In the former event, I hold that low amputation of the uterus is a justifiable procedure, as the patient has already done her duty to the State, and the possibility of further childbearing may be regarded as a matter of relative indifference. In the latter event, on the other hand, I feel strongly that such interference is highly reprehensible, and that decapitation is preferable to forever abolishing the reproductive function of a young woman.

This question was brought acutely to my

attention by one of my assistants having elected in such circumstances to do a Porro cæsarean upon a young and illegitimately pregnant primipara. I would therefore state that I consider it a serious abuse to perform a conservative section in any case of neglected shoulder presentation, and that a Porro operation is no less reprehensible in the case of a primiparous woman.

Recently a considerable literature has accumulated upon the propriety of resorting to cæsarean section as a means of diminishing the fœtal mortality in breech presentations. I have no hesitation in stating as a general principle that I consider such a procedure little short of scandalous, provided the pelvis is approximately normal and the child not excessive in size. Experience teaches that in such cases the average fœtal mortality falls below 10 per cent, while that of the mother is not increased over that occurring in vertex presentations, so that it does not seem reasonable to diminish the mother's chances by several per cent for the sake of increasing those of the child by a corresponding amount.

I will admit, however, that the operation may be justifiable in the exceptional event of a first pregnancy occurring just prior to the expected onset of the menopause in a primipara with rigid soft parts, should she deliberately elect to expose herself to a somewhat greater risk in order to ensure the best possible chances to her first and last child.

Similar arguments have been advanced in favor of similar treatment in certain cases of brow and face presentations, and they deserve the same characterization as in the previous section.

In the absence of disproportion between the size of the head and pelvis, persistent brow presentations do not occur, and as the transient forms ultimately become converted into either vertex or face presentations, it is evidence of profound ignorance of rudimentary obstetrical principles to suggest the advisability of resorting to cæsarean section to overcome a transitory phenomenon, which will take care of itself if left alone. On the other hand, the discovery of a persistent brow presentation at the time of labor indicates that the existence of the causative disproportion had been overlooked at the preliminary examination, and such neglect or failure entails the unpleasant consequences, to which attention was directed in the section upon contracted pelvis.

To my way of thinking, uncomplicated face presentations offer a problem approximately identical with that involved in breech presentations, which needs no further elaboration.

Finally, in this connection, I would call attention to the preposterous proposition of a recent writer that occipitoposterior presentations are occasionally best treated by cæsarean section. Various American contributions to the treatment of this variety of vertex presentation have revealed such abysmal depths of ignorance concerning the mechanism of normal labor that one is not surprised at such a proposition, which can only be regarded as another manifestation of the defective facilities for teaching practical obstetrics which so generally prevail in this country.

The fifth and last abuse to which I shall refer consists in the exploitation of the teachings of Reynolds that cæsarean section is sometimes indicated as an elective procedure in women who are constitutionally unfitted for childbearing, but who present no evidence of mechanical disproportion. Doubtless, in the hands of Reynolds and a few other experts, indications of this character have been productive of excellent results. I know, however, from my own experience that they are difficult of precise application, and from my acquaintance with other men, I am confident that they are frequently abused.

No one appreciates more than I the beneficent results which have followed the lowering of the mortality and the consequent greater usefulness of cæsarean section; but I feel that the time has arrived when a halt should be called upon the indiscriminate employment of the operation by many who are ignorant of the fundamental conceptions of the obstetric art. We should always bear in mind that the decision to resort to cæsarean section is a confession

that Nature has failed to fulfill her obligations, and that it is the duty of the conservative obstetrician to limit his interference to the greatest extent consistent with the welfare of his patients, and not to be led astray by the glamour of an easy operation.

Each year in my ward classes, I take particular pleasure in demonstrating patients with "border line" contracted pelves, who have been delivered spontaneously, and I always say that any young assistant could have obtained a satisfactory result by means of cæsarean section, but that a much greater degree of skill and experience is required to obtain an equally satisfactory result without it. What we need in this country are more thoroughly competent obstetricians and fewer skillful, but indiscriminate, surgeons.

A STUDY OF FŒTAL MATURITY IN UTERO[1]

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THE investigation of fœtal maturity before birth has all the attractiveness of a problem in Euclid and is attended by the same facility of demonstration. The proposition is advanced, the tests applied, and the result set down. In due time the babe is delivered and immediately the antepartum findings are confirmed or confuted. A further interest is lent to the inquiry by the fact that while the importance of the pelvic measurements has been universally conceded and taught, it has been quite as universally asserted and impressed upon students that no estimate of fœtal size *in utero*, nor of the cephalic diameters is in any satisfactory degree possible. Owing to this apathetic or incurious attitude such meritorious methods as we have employed in this study have been left unpracticed although they have been before the profession for years and only occasionally has some pertinacious enthusiast continued the work and furthered the cause. Without claiming for this subject a greater usefulness than we attribute to the pelvic measurements, its equality in value is undeniable while the maneuvers themselves have a precision in operation and a susceptibility to proof that is far more gratifying.

Inasmuch as human gestation may vary from 241 to 336 days, it is obviously essential to know when a labor ought to occur. From the standpoint of the hospital, the expense must be considered seriously when a waiting patient is kept in the ward week after week, and on the part of the patient the long period of uncertainty may not only be attended by expense but by a definite strain on the nerves that impairs the health. Yet, notwithstanding these requirements, very few hospital cases, either from ignorance, indifference, or lactation can give the time of the last menstruation or remember the date of quickening. So, while it is true that labor does not occur necessarily at the time of fœtal maturity, yet it is highly gratifying to discover, through an estimate of that maturity, a probable date whereon in all fitness and propriety the gestation should naturally terminate. For the solution of obstetrical problems, furthermore, this knowledge is a real necessity. In placenta prævia; acute and chronic diseases of the heart, lungs, and kidneys; as well as in the vast field of pelvic contraction, no interference can be attempted, rationally, without an acquaintance with the measurements specifically involved.

In the series of one hundred cases on which this study is based, we have painstakingly employed three different methods and have secured results, which, if not invariably accurate, are at least practically successful in the majority of instances and highly illuminating in all. It has been no part of our purpose, however, to employ the X-ray, partly because this aspect of the question has been elucidated recently by Keith, but more particularly because we preferred to try more gener-

[1] Read before the Chicago Gynecological Society, January 19, 1917. (For discussion, see p. 222).

ally available instruments like the pelvimeter and tape.

Before reviewing our work analytically, it may be well to state that early in our investigations we abandoned the weight of the child as a reliable factor in the estimation of maturity. We may admit that long babies are usually heavy babies but is it not possible that this fatness merely indicates prolonged detention and a postmature child?

Babes put on weight in the uterus as easily and as variably as after birth, and the presence or absence of a certain heaviness should not be an evidence of maturity in the embryo any more than in the adult. Babes of the same weight may exhibit marked differences in length, while babes of the same length will vary notoriously in weight though all are mature. We must not forget, moreover, that heaviness is a sign of present nutrition while length is the indication of past assimilation.

The deposit of fat in the babe, as in the adult, demonstrates that the intake of nourishment is not fully utilized; that the limit of elaboration has been reached under the existing conditions, and the unusable material must be stored up. In other words, the child is mature and a further growth is enforced by the unaccountable delay in uterine activity.

A fat child is not necessarily a healthy child and in many instances is extremely liable to rises of temperature, but fat babies are much more difficult to deliver and show a higher mortality as well as a higher maternal morbidity than normal babes.

The average weight of the babes in this series is 7 pounds and a half. The largest weighed 9 pounds and a quarter and the smallest remained at 5 pounds and 5 ounces though both were mature. So long as the length is normal the weight may range from five to eight and a half pounds, but owing to the accidents and uncertainties associated with the beginning of labor, it is more than probable that a large percentage of babes (von Winckel says 72 per cent) weighing more than 8 and a half pounds are postmature and will show an excess in length to confirm the statement.

The birth of these large babies, however, is a serious affair, not to say dangerous, and the time is coming when, as McDonald says, "a 10 pound child will be a reproach to the obstetrician rather than a distinction to the parents." This brings us to the question that is bound to suggest itself, as to what constitutes maturity, and while our present knowledge does not permit an exact biological answer, it would seem that maturity might be defined, tentatively, as that state or degree of fœtal development wherein the child is enabled to surmount the perils of extra-uterine life easily. But what are the signs of this maturity? If weight is unimportant, on what should a diagnosis be based?

In the present study we have found certain approximate standards of size and age to be the most reliable guides; such as—

1. The length of the child *in utero* which should verge upon 50 centimeters.

2. The duration of the pregnancy as determined by careful measurements of the uterus rather than by the lapse of time since the last period, or, by calculation from the more important date of quickening, no matter how accurately these events are known.

3. By the size of the fœtal head which should measure from 8.5 centimeters to 10 centimeters in the biparietal, and from 10 centimeters to 12 centimeters in the occipito-frontal diameters.

This is the more reasonable since the wide latitude in the time of conception, the uncertainty as to the normal duration of pregnancy and the haphazard character of the onset of labor, gives to the history of the case a merely confirmatory significance.

The length of the child may be obtained by Ahlfeld's method.

The fœtal attitude *in utero* is one of complete flexion, and Ahlfeld determined that the true length is double the length of the folded child, hence the rule: Measure, with a pelvimeter, from the well differentiated breech of the child to the upper border of the symphysis where the head usually rests. Subtract two centimeters to allow for the thickness of the abdominal wall and multiply by two. The result is the length of the child. The same method is practiced in breech presentations.

How accurate is the rule? The cases herewith reported, originally numbered 105, of which five were discarded for the following reasons:

1. A premature detachment of the normally implanted placenta wherein the uterus was so incompressible that a good technique was not possible.

2. Acute hydramnios.

3. A macerated fœtus, where no two results agreed.

4 and 5. Women with extremely fat abdominal walls through which it was impossible to outline the babes with any certainty. One had, in addition, a pendulous abdomen.

In the 100 cases where measurements were possible, we obtained the following results:

The antepartum estimate tallied exactly with the postpartum findings in 37 per cent, and varied less than 0.5 centimeters in 24 per cent of the cases. Since 0.5 centimeters is less than a quarter of an inch it does not seem unwarrantable to include these cases with the first which would give us 61 per cent of practically correct estimates.

In 29 per cent the miscalculation ranged from 1.0 centimeter to 1.5, while of the 10 remaining, 8 (1 being premature) had a variation of 2 centimeters, 1 was 2.5 centimeters and another 4 centimeters too large. The error in this last case is not explainable. To be sure it was a breech presentation and yet one other case was a breech and the calculation was correct. In only 24 per cent of the series did the postpartum findings exceed the antepartum estimate. The rest were exact or safely below the true length.

There was no definite relation in these cases between the length and the weight, for while the largest child was 50 centimeters long and weighed 9 pounds and a quarter the smallest was 49 centimeters long and weighed only 5 pounds and 5 ounces. Since babes grow in the uterus at the rate of 0.9 centimeters a week, in length, the difference could not be due to prematurity in the one case, nor, if we accept 50 centimeters as the standard of length, could there be undue detention of the other babe unless we could prove that the 50 centimeters length had existed for some time.

Drs. O'Connor and Koklhase who made many of these examinations at Wesley Memorial Hospital found all the methods easy to apply and increasingly accurate with use. A specimen chart is herewith introduced to illustrate our system of operation. In the sixth column the larger number represents the result of the direct occipitofrontal measurement and the smaller figure our estimate of the biparietal diameter. In the ninth column the corresponding figures show our postpartum findings.

The McDonald measurement is really an estimate of maturity although originally put forward as a means of determining the advancement of the pregnancy. It is hardly fair therefore to bring it into competition with the Ahlfeld which is so distinctively a maneuver for obtaining the length of the fœtus. However, the advancement of the pregnancy is an integral part of the problem of fœtal maturity and the McDonald measurement is an important factor in the solution. Therefore, for the benefit of those who are not familiar with his work a summary of the McDonald technique is presented:

One hand holds an end of the tape at the upper border of the symphysis. From this point, the hand carries the line upward, following the rotundity of the uterus closely until it dips beneath the ensiform cartilage. Here the finger tips are pressed down until the highest limit of the fundus is attained. The tape, meanwhile, held between the thumb and the index finger, does not follow the dip to the very bottom but the scale is read at a place in exact line with the upper border of the fundus and an inch or an inch and half above it.

In multiparæ the uterus must be brought into the median line by lateral pressure and the long axis of the child made parallel with the long axis of the mother while the measurement is taken. Inasmuch

Patient's name, Mrs. Anna Goldstein; age 19. Neither time of last menstruation nor date of quickening was known.

Date	Ahlfeld	Estimated Length	McDonald	Estimated Period of Pregnancy	Occipito Front Diameter	Delivery	P. P. Length	P. P. Diameter Bipar	P. P. Weight
3/20/16	24½	45	28	8	9¾ 7½				
4/12/16	26	48							
4/19/16	26	48			11½ 9¼				
5/2/16	26½	49	31	9	11 8¾	May 2	48.5	11 8.5	5½

as judgment and experience are required in every instance to decide just how much pressure must be used by the fingers holding the upper end of the tape it would seem as if some means should be devised to avoid this second variable factor, but it is not clear at present just how it could be done.

Assuming a normal pregnancy to extend through ten lunar months, McDonald claims the fundus should be 35 centimeters above the symphysis at term. Then since the child grows at the rate of 3.5 centimeters per month (after the fifth month), 35 is divided by 3.5 and the result is 10 or the month of the pregnancy.

Suppose the tape gives 34 centimeters as the height of the fundus, then 34 divided by 3.5 equals 9.7 months as the period of the pregnancy.

McDonald states that in every instance where the tape measures 35 centimeters, the child is certainly mature and the woman at term. Our observations bear out this statement; in fact we were impressed with the feeling that McDonald allows a little more margin than is actually necessary.

In our series we used the Ahlfeld and McDonald methods as checks upon each other and for the most part found them mutually corroborative, although in a certain percentage of cases the McDonald was low when the Ahlfeld was exact.

We found:

14 cases with a McDonald of 34 centimeters and a postpartum length of 49.3 centimeters and a weight averaging 6 pounds and 14 ounces.

6 cases gave a McDonald of 34.5 centimeters with a postpartum length of 50.8 centimeters and a weight averaging 7 pounds.

22 cases gave a McDonald of 35 centimeters, a postpartum length of 50.8 centimeters and a weight averaging 7 pounds and 6 ounces.

9 were above 35 centimeters and gave an average postpartum length of 51.5 centimeters and a weight of 8 pounds and 5 ounces.

Thus 51 per cent of the whole were 34 centimeters or more in length and averaged 7 pounds and 4 ounces in weight.

Of the whole number 30 per cent had a fundal height of 32 to 33 centimeters before delivery although they were normal babies and mature on postpartum examination. These 30 cases were also estimated by the Ahlfeld method either exactly or within a centimeter which would seem to confirm the theory that the McDonald allows a trifle too much latitude. Indeed our observations on the height of the fundus at term conform more nearly to the results obtained by Varnier and Spiegelberg who report 33 and 33.7 centimeters respectively.

Again the largest child with a weight of 9 pounds and 4 ounces and a length of 50.0 centimeters gave a McDonald of only 33.5 centimeters while the largest McDonald, 37 centimeters, resulted in a child of only 8 pounds and 12 ounces though it was 53 centimeters long. The Ahlfeld estimate in both instances was correct.

Without taking the size of the uterus into consideration, these two cases in themselves draw attention to the lack of relation between the size of the fœtus and its length, or if we may venture the statement, its maturity. It is also interesting to note that where the measurement varied from 34 to 35 centimeters the weight varied but half a pound, but as soon as 35 centimeters was exceeded, the average weight jumped at once to a pound more.

By means of the Ahlfeld and McDonald measurements, twins were diagnosed in two instances and the two sets of heart tones were subsequently identified, one after an hour's search and the other after intermittent examinations for three days.

With due appreciation of the assistance really conferred by the McDonald method, it has, in our experience, seemed a little less reliable than the Ahlfeld. On the other hand the procedure is easy to apply and increases in accuracy the more it is used.

The estimate of the fœtal head diameters has a more comprehensive interest, since it not only helps to establish the maturity of the child but it assumes an immense importance where the pelvis is contracted. This problem has seemed so complicated that few have cared to work on it, and especially in recent years, if we may judge by the literature, the attention directed to it has been scant and the lack of interest discouraging. Nevertheless the method of Perret is well worthy of trial and confidence. The occipitofrontal diameter in most cases lies near at hand, except for the interposition of the uterine and abdominal walls but the biparietal which is most important, is quite inaccessible and must be secured by indirect means. The theory of the method is based upon the existence of a certain relationship between the occipitofrontal and the biparietal diameters. A brief description may not be amiss. The occipitofrontal diameter of the head, as it lies across the inlet, is measured directly with the pel-

vimeter and a figure that varies with the size of the occipitofrontal is subtracted to give the biparietal. As originally presented, an allowance is made for the thickness of the abdominal wall as in the Ahlfeld method, but Stone discovered the results were more accurate if this deduction were omitted.

Then, too, it was Perret's idea to subtract a fixed figure of 2.5 centimeters from the acquired occipitofrontal to get the biparietal diameter. McDonald found that if this were done, the procedure would be exposed to unnecessary inaccuracies and he proposed a sliding scale whereby the deduction should vary as the occipitofrontal diameter varies. Thus an occipitofrontal of 11.25 centimeters has 2 centimeters subtracted to obtain the biparietal while an occipitofrontal of 12.0 centimeters is decreased by 2.5 centimeters.

At Wesley, we have found that McDonald's table of deductions is good in principle but should be so extended that for occipitofrontal diameters of less than 11.0 centimeters only 1.5 centimeters should be subtracted. It is questionable, too, whether it may not be advisable in future to deduct more than 2.5 centimeters from occipitofrontals greater than 12.0 centimeters but these heads are relatively rare and may be left for the present.

The rule, therefore, with the appropriate though arbitrary deductions for the different occipitofrontal diameters obtained, may be thus stated:

By deep pressure over the inlet, obtain the occipitofrontal poles and measure their separation with a pelvimeter. Then to estimate the biparietal diameter from an occipitofrontal of 10.0 centimeters, deduct 1.5 centimeters, an occipitofrontal of 11.0 centimeters to 11.25 centimeters, deduct 2.0 centimeters, 11.5 centimeters deduct 2.25 centimeters, 12.0 centimeters deduct 2.50 centimeters and the result is the biparietal diameter.

How does the rule work in practice? Owing to the head being too deep for examination, the abdomen too thick or too hard, or, on account of such fœtal anomalies as prematurity or maceration, only 85 tests were obtained.

Of these 31, or 36 per cent, tallied exactly with the postpartum findings and 27 more, 31.7 per cent were within 0.25 centimeter. In any pelvis where extraction by the natural passages could be properly undertaken, this trifling error would be negligible and we can, therefore, combine these results into one group. We get then, 67.7 per cent of the examined cases where the biparietal diameter was estimated within 0.25 centimeter or an eighth of an inch. Of the rest, 22 or 25.8 per cent were within 0.5 centimeter and the five remaining were within 1.0 centimeter.

Thus in 94 per cent of our cases we obtained the biparietal diameter either exactly, or within 0.5 centimeter which is well inside the workable limits, though not ideally correct.

Another interesting phase of the investigation remains. How nearly do we secure the occipitofrontal diameter, by direct measurement, when no allowance is made for the thickness of the abdominal wall?

We found the results to correspond exactly in 40 per cent and within 0.25 centimeter (one-eighth of an inch) in 34 per cent of the cases, or if we may be permitted again to unite two groups, in 74 per cent of the whole number. Twenty-four per cent were within 0.5 centimeter and 2 per cent within 1.0 centimeter. McDonald's experience was even better since his estimates tallied exactly with the postpartum findings in 72 per cent of his cases.

CONCLUSION

As a consequence of this study, the writer is convinced that we have in these procedures the means of obtaining with reasonable accuracy a knowledge as to the proximity of fœtal maturity, and even as to the existence of postmaturity.

The Ahlfeld is workably correct in 61 per cent and the McDonald in 51 per cent of the cases. It is possible another series might give better results with the experience acquired, especially with the McDonald, for the originator of the method gets a higher percentage of correct estimates than we do. Moreover, in those cases where the findings are inconclusive, the information obtained is so valuable that it cannot be disregarded in justice to the patient.

The Perret is even more needful if possible, since it reveals the despotic biparietal diameter with practical accuracy in from 68 per

cent to 94 per cent of the cases. In contractions of the pelvis, furthermore, where all these diameters and measurements are most necessary, we find these methods are easier to apply and more generally reliable in results.

An extreme Ahlfeld or an extreme McDonald usually means a large child but it should also arouse a suspicion of twins.

A sudden diminution of the Ahlfeld or the McDonald measurement after being regularly observed may be the first indication that the head has entered the pelvis. When the head is in the pelvis the Ahlfeld and the McDonald are not so reliable and the Perret is unobtainable, but for the same reason they are unnecessary.

We believe these procedures are entitled to far wider employment and more confidence than they have received hitherto, and that they should be regularly practiced as well as taught in the schools.

Finally, the writer wishes to reiterate for emphasis his opinion that mere fatness in many cases is not so much a sign of fœtal maturity as of overlong detention in the uterus.

THE USE OF DESICCATED PLACENTA

With Special Reference to the Vomiting of Pregnancy[1]

By EUGENE CARY, S.B., M.D., Chicago
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TO explain my reason for administering placental extract to pregnant women, a theory or theories must be advanced to determine the action that the substance in most probability, will have; then by its administration to prove that this action has taken place.

Leo Loeb[2] in 1909 showed that the corpus luteum sensitizes the endometrium for the reception of the fertilized ovum. This action is the lowering of the resistance of the host or at least, the uterus of the host to this foreign protein (the ovum), thus making it possible to exist and not be absorbed. Now that the ovum is imbedded and growing, a relative immunity must be established by the pregnant woman against the products of conception.

The growing ovum acts as an antigen and stimulates the host to the formation of antibodies. This is in accordance with Ehrlich's theory of immunity with which we are all more or less familiar.

A. H. Curtis[3] demonstrated the death and absorption of living ova in the uterus of the guinea pig and the rabbit, by the subcutaneous injection of placental extract.

[2] J. Am. M. Ass., 1909, Oct. 30, 1471.
[3] Surg., Gynec. & Obst., 1915, xx, 292.

Rabbit 1. Dosage 40 cubic centimeters. Abortion of one one-third developed macerated fœtus on third day. Killed. Five fœtus *in utero* in varying stages of absorption. Corpora lutea absent. No signs of infection.

Rabbit 2. Dosage 25 cubic centimeters. Abortion of five three-quarters grown, slightly macerated fœtus on fourth day. Killed. Corpora lutea absent. No signs of infection.

Rabbit 3. Dosage 20 cubic centimeters. Dose repeated two days later. Rabbit well. Killed four days after second injection. Seven corpus luteum cysts in left ovary, four in right ovary. These are the largest corpus luteum cysts yet seen in a rabbit. Uterus contains four young fœtus in each horn, all partially absorbed. No signs of infection.

Rabbit 4. Dosage 20 cubic centimeters. Killed two days later. Uterus boggy. Contains half dozen milky accumulations, suggestive of absorption of ova.

Guinea pig 4. Dosage 4 cubic centimeters. Aborted three nearly mature fœtus on third day. Discharged in good condition.

Guinea pig 5. Dosage 3 cubic centimeters. Aborted three two-thirds developed fœtus on second day. Discharged in good condition.

Guinea pig 6. Dosage 2 cubic centimeters. Littered two pigs within 24 hours. One died same day; other healthy. Mother discharged in good condition.

The results of these experiments may be explained by the fact that the injection of placental extract increases the resistance or

[1] Read before the Chicago Gynecological Society, January 19, 1917. (For discussion see p. 222.)

raises the immunity of the host to such a degree that the existing balance is altered, causing death and lysis. Even in older pregnancies the action is sufficiently strong to cause death of the mature fœtus and resulting still-birth.

One case of my series, a woman with pre-eclamptic toxæmia, was given 15 grains of desiccated placenta orally, for a period of 10 or 12 days. A still-birth resulted with the important fact that toxic symptoms of the mother became no worse during administration and the blood-pressure dropped about 20 millimeters of mercury.

From Ehrlich's theory we may reasonably assume that if the host does not react to the antigenic action of the growing ovum such a condition as toxæmia will result, and if the inhibiting action against the invasion of the ovum were diminished, it would follow that the syncytium would tend to grow more profusely.

G. Acconci[1] has demonstrated that in the placenta of the toxæmia of pregnancy, there is an *intense atypical proliferation* of the syncytium which penetrates the villi. In other cases conglomerations of the villi are formed that lead to disturbances in the circulation in the subdecidua by degeneration, fibrin formation, and stratification.

The question next arises: is the condition not due to the diminished proteolytic ferment in the blood? The Abderhalden reaction is negative or very weak in toxæmia of pregnancy (De Lee). This indicates that the ferments are diminished in a greater proportion than the antiferments, for under normal conditions, Singer and Quantz[2] have shown that "Substrates (i.e. placenta tissue) neutralize antitryptic bodies in the blood serum, thus permitting fermentation of the nitrogenous constituents of the serum. This autolysis, if not carried too far, will cause a positive Abderhalden reaction."

If the ferment content of the blood is lower than in normal pregnancy, then the splitting of toxic split-products in the serum, to lower and non-toxic forms is diminished and we have an accumulation of toxic substances. This has been definitely proved to be the case in lobar pneumonia before crisis by the work of Jobling and Peterson.[3]

These findings suggest that perhaps the absorption of fibrin or products of early autolysis may be the cause of toxæmia.

Very early in the growth of the ovum there is first a degeneration of the trophoblast,[4] and in Peter's ovum there is, in some regions, what is almost entirely degenerating syncytium.[5] Bryce and Teacher describe a zone of coagulated, necrotic fibrin around the ovum. Typical fibrin striæ probably occur only after the cessation of the phagocytic activity of the trophoblast. Degeneration may be observed according to R. Bonnet[6] in the syncytium in younger stages of ova. In older ova, as described by F. Marchaud.[7] There are transitions of synctium into fibrin. Nitabuch's fibrin stria appears in the transitional zone between the maternal and fœtal tissues. There are other deposits, as for example, the Langhans stria which lies close beneath the chorionic plate. This last appears between the syncytium and the connective tissue of the villus and is of fœtal origin.

J. Young[8] pointed out that toxæmias of pregnancy are due to the liberation of the products of early autolysis of the placenta, because they are associated with recent infarction of the placenta, and the placenta is so constructed that the products of the dying patch can pass directly into the blood stream.

I think that the disturbance in circulation, causing this necrosis and infarction, aside from accidental hæmorrhage, may be explained in part, by the observations of Acconci previously mentioned. Young further states that these facts suggest that toxæmias are due to autolytic products of dying placental tissue, and by imitating the process occurring *in utero* he is able to isolate from the healthy placenta, soluble materials, that when injected caused: (1) convulsions, (2) peripheral focal necrosis in the liver, and

[1] Folia Gynaec., 1914, ix, 1.

[2] Arch. Int. Med., 1916, October, 537.

[3] J. W. Jobling, W. F. Peterson, and A. A. Eggskin. J. Exp. Med., 1915, xxii, 568.

[4] Keibel and Mall. Human Embryology, p. 124.

[5] Ibid., p. 125.

[6] Monatschr. f. Geburtsh. u. Gynaek., 1903, xviii.

[7] Beobachtungen an jungen Menchlichen eiern. Anat. Hefte, vol. xxi, 1913.

[8] J. Obst. & Gynæc. Brit. Emp., July 14, 1914.

(3) degenerative lesions in the kidneys, especially in the convoluted tubules.

Deficiency in the action of the thyroid has been suggested as a cause of toxæmia. Howell says that one of the functions of the thyroid gland is to neutralize or destroy toxic substances formed in the metabolism of the rest of the body. Rogers and Garnier, Hunt, and others have shown that the thyroparathyroid is antagonistic to bacteria toxins, and certain other poisons as well as toxic waste products. In summing up, Sajous says that the physiological action of thyroid preparations may be summarized as follows:

1. They enhance oxidation by increasing the inflammability of the cellular phosphorus, and by enhancing the functional activity of the adrenals.

2. Their power to enhance the inflammability of cellular phosphorus extends to pathogenic elements, waste products, etc.[1]

The thyroid secretion then must rid the body more quickly of toxic waste products by increased oxidation.

I have given desiccated placenta because (1) if the condition is due to a lowered immunity of the host to the growth of the syncytium, as seems probable by the work of Acconci, it may stimulate by acting as an antigen. The work of Curtis would also bear this out. (2) If the proteolytic ferment is lower than normal, as demonstrated by the negative Abderhalden reaction, it may increase the ferment content of the blood. (3) The placenta may be a gland of internal secretion, and it may increase the action of the thyroid and adrenals, and by so doing hasten the oxidation of partial protein, split-products being thrown into the circulation.

I have collected thirteen cases of vomiting of pregnancy, which have occurred at different periods during gestation. One or two of these developing later in pregnancy, as they did, might have developed into the pernicious type had they been allowed to continue. Of these thirteen cases two were lost sight of. Of the remainder, seven stopped vomiting within a day or two and the nausea soon disappeared. Two improved and remained fairly free from nausea, although the administration of the extract had to be continued over a longer period of time. In the remaining two cases the results were not satisfactory; one was definitely neurotic.

At my suggestion Dr. De Lee has used the extract in six cases, with good results in three, and varying success in the remainder. He has also used it in two cases of urticaria of pregnancy, from which prompt and lasting relief was obtained.

I will in brief give two case reports to demonstrate vomiting at different stages of gestation.

CASE 1. Mrs. T., III-para, age 34, six months pregnant. She menstruated regularly during the first three months of pregnancy. During the fourth month she had an attack of bronchitis. In the sixth month she suddenly developed "morning sickness" which in the course of two or three days developed into uncontrollable vomiting. A capsule (5 grains) of desiccated placenta was given, three times daily, with only enough water to facilitate swallowing; within two days she had stopped vomiting and was delivered at term.

CASE 2. Mrs. H., II-para, age 36, six weeks pregnant, complains of "morning sickness." Three five grain capsules of desiccated placenta given daily for three days, with complete cessation of symptoms.

In conclusion I wish to state that on account of the great scope of this subject, it is not the intent and purpose of this preliminary report to include the physiology, biochemistry or histopathology of the above-mentioned conditions.

[1] Sajous Analytic Encyclopedia of Practical Medicine, vol. 1, 751.

DEPARTMENT OF TECHNIQUE

HARELIP

By W. A. BRYAN, M.D., F.A.C.S., Nashville, Tennessee

FACIAL defects, congenital or acquired, traumatic or pathologic, are so conspicuous as to be not only an unceasing source of embarrassment to those who have them, but an obnoxious spectacle to one's associates. Therefore they offer a twofold demand for correction. And this correction deserves to be not simply an attempt to relieve the disfigurement. It should, to accomplish the end desired, be the best possible correction. The net result, while primarily cosmetic, must not lose sight of the fact that function must be maintained or improved according to the necessities presenting. The correction of such defects as are described below is not so simple a matter as one might judge by the readiness with which so many are undertaken. The inferior results often seen, results that should cause one to prefer the original deformity, are loud witnesses to the truthfulness of the above statement. Such failures grow naturally out of two factors: one is inexperience; the other, failure to recognize certain fundamental elements pertaining to all plastic work, and certain others that apply only to the particular site of the lesion to be dealt with. This statement applies with especial relevancy to correction of harelip.

This discussion has been undertaken not with a purpose to review the literature, but to illustrate from practical experience the factors which have made success more sure. The object undertaken is the correction of harelip alone or associated with cleft palate. The cases on which this paper is based number something more than two hundred. The age of the patients varied from two weeks to more than forty years.

Harelip may be complete, by which it is understood that the cleft extends from the free margin of the lip into the nose, so that the attachment of the ala nasi to the septum is severed and the ala flares outward and is flattened, often even depressed. If the alveolus is cleft, there is a consequent deviation of the nasal septum toward the side of the cleft, the degree of which depends upon the advancement of the os incisivum. Harelip may be incomplete in any extent, from the slightest gap in the free margin of the lip to the narrowest band separating it from the anterior naris. The lesser degrees of the incomplete type are not usually associated with deformity of the nostril, but may be occasionally; and this especially when there is an associate cleft palate dividing the alveolus: of course, with increasing degrees in the harelip there is a greater chance of disfigurement of the nostril and deviation of the septum.

Harelip, complete or incomplete, may be either unilateral or bilateral, and the bilateral type, as the unilateral type, may be associated with, or occur independently of, cleft palate. What has been said of the unilateral complete or incomplete type not associated with cleft palate involving the alveolus is true of the bilateral type similarly free from clefts in the alveolus. The defects become symmetrical. Usually in these double cases there will be little or no deviation of the septum. However, when bilateral cleft of the alveolus occurs a new, most difficult phase presents itself. The nostrils flare outward, so badly sometimes as to give the impression that the nose is greatly diminished in size. The septum fortunately is straight. The os incisivum juts forward to the tip of the nose, and occasionally as much as one-half inch beyond the tip. The small median portion of the lip covering the upper surface of the malposed os incisivum, the part that should normally form the philtrum, is not continuous from the posterior margin of the nasal septum as it should be, but arises at some point usually considerably anterior to the posterior limit, and often from the skin at the very tip of the nose, whence it turns abruptly forward to cover the os incisivum. This represents the acme of harelip and cleft-palate disfigurement.

There are, as hinted at above, certain fundamental facts that obtain in all plastic work. They are, therefore, necessary in correction of harelip and its associate disfigurements. They are so simple, so universally known, that one might apologize for even referring to them, were it not true that oversight of them is responsible

Fig. 1.

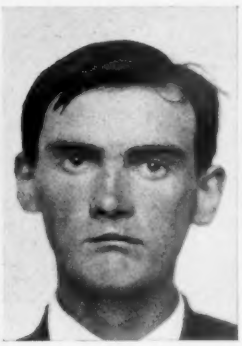


Fig. 2.

Fig. 1. Incomplete harelip associated with cleft of hard and soft palate.
Fig. 2. Same case ten days after operation.

Fig. 3.

Fig. 4.

Fig. 3. Bilateral incomplete harelip.
Fig. 4. Same as Fig. 3 four weeks after operation.

for many, if not most, of the failures in correction of facial defects. They are: (1) That a sufficiently wide raw surface should be made on each coapted part to guarantee union of the full thickness of the lip. Simple as this proposition is, the great frequency of a groove along the cicatrix in the lip, with a corresponding groove on the mucous side, eloquently witnesses that it is often forgotten. (2) The tissues should be clean cut, and their blood supply and the integrity of the cells of the raw surfaces should be reduced as little as possible. No ligatures should ever be applied to the cut surfaces; they are unnecessary. If ligatures must be used they should be passed into the tissues of the lip away from the line of union. (3) The coapted surfaces must fall easily together, no matter how much dissecting is required to relax them, or how much time it requires to narrow the width of the harelip, whether during or prior to the operation. (4) Relaxation must be maintained continuously from completion of the operation until healing is perfect. Function, voluntary or involuntary, must not be allowed to disturb the line of union. The large number of partial failures and occasional complete ones indicate the need especially for the last three items.

The question as to the time of operation in these cases is an important one, more important when there is an associated cleft palate. It should be understood that every harelip should be corrected regardless of the patient's age, and so far as simple, incomplete harelip is concerned its correction should give uniformly good results regardless of age. But where the nostril, the nasal septum, and the alveolus enter for consideration, the results usually are better the younger the age at which the operation is done. However, this should not be accepted as a disparagement to those who have reached maturity, as may be seen from a glance at the accompanying illustrations. When the surgeon may elect

Fig. 5. Bilateral harelip and complete cleft palate. The os incisivum had been removed when an infant.
Fig. 6. Same case two months after correction.

Fig. 7. Incomplete harelip with marked labial groove.
Fig. 8. Same as Fig. 7 after operation.

Fig. 9. Incomplete harelip.
Fig. 10. Same as Fig. 9 ten days after operation.

the age at which he will operate, he will make no mistake in choosing to operate at the earliest date possible. This usually means when the child is about three or four weeks old; i. e., as soon as the mother is able to travel. The best results in cases of cleft alveolus, deviated septum, and protruding os incisivum must be sought before the child is six months old, while the bones are still in the cartilaginous state and pliable. Waiting until a later age necessitates cutting to get the alveolar arch into position, and militates against correct contour of the arch inasmuch as cutting permits rotation at one point only.

Ether anæsthesia is employed in all cases, and no complications or accidents have been incurred in my cases. I have on one occasion been compelled to do a major operation under ether anæsthesia lasting one hour on a child nineteen hours old. There was no difficulty throughout and the child recovered uninterruptedly. This is mentioned on account of the frequent question as to how young a child can take ether safely.

The special items in this line of work to be considered are just as important as the general rules of plastic surgery laid down above, for it is altogether possible that one may be able to get a perfect operative result, with so poor cosmetic and functional results as to render the operation worse than worthless; for it is always more difficult to reoperate on harelip cases than to do the work at first. Hence we are compelled to get not only a union of the cleft, a closure, but we must make the patient look like a human being. The special items to be considered are: (1) to give an even margin to the lip; (2) to reconstruct the anterior nares so that they will be of equal size; (3) to place the alæ in such position that they will appear symmetrical, i.e., so that a horizontal and a vertical transverse plane will intersect the alæ on the two sides of the nose at corresponding points; (4) to give proper prominence to the upper lip without undue protrusion.

1. Why even a casual observer should see so many corrected harelips with either a groove to which reference has already been made, or a

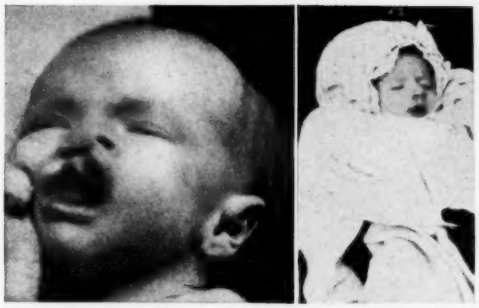


Fig. 11. Three-weeks-old infant with complete unilateral harelip and cleft palate.
Fig. 12. Same as Fig. 11 two weeks after correction of alveolar arch and lip.

V-shaped margin, or a drop of the lip on one side or the other of the scar, like a single-stair step, it would be impossible to guess. But one thing we may be sure of; namely, that the lip was not properly cut, or was approximated incorrectly, or was not held in approximation sufficiently long. This defect is such that it is but little better than a harelip. This same accident has evidently been happening for a long time, for from time immemorial surgeons have instructed us to approximate the margin, "the vermilion border," of the lip first. I do not think it necessary to follow this rule except in cases of incomplete harelip. In complete cases it is probably better to approximate the nostril first. At any rate a much better rule would be to approximate the margin of the lip correctly. This cannot be done by any plan that unites the two sides of the

Fig. 13. Five-year-old girl with bilateral incomplete harelip.
Fig. 14. Same as Fig. 13 eight weeks after operation.

Fig. 15.

Fig. 16.

Fig. 15. Unilateral harelip and cleft palate in girl of sixteen.

Fig. 16. Same as Fig. 15 eight days after operation. Showing correct protrusion of free margin of lip.

Fig. 17.

Fig. 18.

Fig. 17. Incomplete harelip, marked groove, and complete cleft palate.

Fig. 18. Same as Fig. 17 taken six weeks after operation.

cleft into a straight line; for, when healing occurs and contraction of the cicatrix follows, the inevitable V results, no matter how satisfactory the work from a technical standpoint. On the other hand, the essentials of gaining a natural appearance of the lip depend first on closing in an angular or curved line, and second in making slight overcorrection at the margin, i.e., suturing the margin so that it bulges downward at this point. All the illustrations shown are corrected in this manner.

2. The size of the nostrils can very easily be made unequal: it might be more properly stated that it is difficult to make them equal in size, owing to the fact that when the ala is approximated to the septum its flattened surface is almost certain to buckle, usually outward, and render comparison with the other round or oval nostril difficult. The best rule to follow here is to prepare the septal surface first and remove a minimum thickness from the alar surface. The buckling that occurs when the nostril is sutured need cause no concern; it readjusts itself.

Fig. 19.

Fig. 20.

Fig. 21.

Fig. 19. Child on whom the lip, nose, and alveolus were corrected three months before. Complete bilateral harelip and cleft.

Fig. 20. Unilateral harelip and cleft palate six months after operation.

Fig. 21. Unilateral harelip and cleft palate. The lip and alveolus were corrected one year ago.

3. In mentioning this item of symmetrical nostril, reference is not made to the size but to the position of the alæ. It is an easy matter to suture the ala to the septum in such a manner that it is higher or lower, usually the latter, than on the normal side. This is the reason assigned for the statement already made that it is perhaps better in complete harelip to suture the nostril first, in preference to following the old rule of suturing the margin of the lip first. It is also necessary in suturing the alæ that the two sides appear posteriorly the same distance from the margin of the septum.

4. There is no part of the result of harelip and cleft palate work that adds more to the good appearance of the patient than correct prominence of the upper lip, nor is there anything more capable of giving him the foolish face of an imbecile than dealing with the mouth in such a manner that the upper lip appears depressed, giving the nose undue prominence at its lower border, and, in profile, causing the patient to look as if his upper jaw had been forced back a half inch or so into his face. Obviously, these items pertain only to those cases where harelip is associated with unilateral or bilateral cleft palate. In bilateral cases this feature is doubly important.

Correct prominence of the lip is intended to signify that the os incisivum shall be replaced and held into position until healing occurs and yet not show too great prominence of the lip or too much depression. The latter is the worse. In young infants (under three months of age), when the cleft is unilateral, all that usually will be required is to freshen the two alveolar margins and spring the os into position by manual pressure and maintain the new position by wire that passes through each superior maxilla and the hard palate, encircling the cleft completely, with an occasional additional suture.

If, on the contrary, the opening through the alveolus is bilateral, the restraining influence is entirely lost and the os incisivum is jutted forward in all degrees even until it extends beyond the tip of the nose. If this protrusion is slight, the edges of the cleft on each side may be pared and the bone forced into position and held by the encircling shotted wire, as was suggested above for unilateral cleft. If the bone cannot be replaced in this way, or if such reposition enforces rotation of the os incisivum on its transverse axis causing the upper incisors to be erupted so that their free margins upon occlusion would lie on the buccal rather than the labial side of the lower incisors, it will be necessary to resect subperiosteally a sufficient segment from the nasal septum to make correct reposition easy. When a sufficient resection is done, the os may be replaced by fracture of the remaining bony pedicle. This releases all bony attachments and renders it necessary to suture it to the maxillæ on either side, in addition to the circular wire suture; otherwise backward depression of the free margin will almost invariably occur.

One serious difficulty presents in severe cases of protrusion where the os incisivum is directly attached to the anterior margin of the nasal septum at the very tip of the nose. This difficulty consists in the fact that reposition of the os, as outlined above, carries with it the tip of the nose and produces an incorrigible and hideous flatness of the nose, which neither future development nor surgery will improve materially. To avoid this it is necessary to dissect the small segment of lip covering the anterior (upper) surface of the os away from the underlying bone, leaving it attached by the pedicle to the tip of the nose; then to sever the os incisivum from the nasal septum far enough backward to allow for normal nostrils, and to suture the pedunculated portion of the lip to the lower edge of the septum, thus affording a cutaneous rather than a cicatricial border between the restored nostrils. If the pedicle is long enough to reach farther backward than this feature requires, the excess should not be sacrificed, but should be incorporated in the lip, after the arch is corrected.

In cases in which at a previous operation the os icisivum has been sacrificed, the contour of the face (lip) can be restored only by transplanting a pedunculated section from the nasal septum, so that it occupies a space between the margins of the maxillæ, or by wearing a plate or bridge to fill this space.

In all cases of harelip surgery, it is unwise to apply dressings. The only dressing necessary is adhesive straps applied in such manner as to avoid all possibility of tension being made on the line of sutures until healing is complete.

Attention is called to an important result obtained incidentally in this work, which can almost invariably be observed in individuals who have been operated upon after reaching the age of self consciousness. The whole countenance changes for the better, as can be observed by covering the lower half of the face before and after operation and comparing the upper halves. So much for the psychological effect of harelip and its correction.

SUSPENSION IN BRONCHOSCOPY AND ŒSOPHAGOSCOPY[1]

By ROBERT CLYDE LYNCH, M.D., F.A.C.S., New Orleans, Louisiana

IN my earlier writings and correspondence with my colleagues, I have stated that the use of suspension was not an essential in bronchoscopy or œsophagoscopy, and I am still of this opinion in adult subjects, where the reason for the use of the tubes is not a foreign body impacted in the larynx or just behind the cricoid in the œsophagus. In these instances, even in adults, the suspension will facilitate the removal of such a foreign body better than the spatula or the tubes alone. But in children and infants, I have been using the suspension for the purpose of the in-

[1] Read before the Clinical Congress of Surgeons of North America, Philadelphia, October 25, 1916.

troduction and manipulation of the tubes with such satisfaction that I feel now that it is becoming a very essential factor in this class of work.

1. Infants and young children are the most ideal subjects for suspension because of their natural muscular undevelopment, their flexible necks, and because of the short distance from the upper teeth to the larynx.

2. It is in infants and young children that the greater percentage of our foreign body cases occur, and it is in these also that we fear most the reactive imflammations and swellings due to our manipulations.

At times it has doubtless been your experience, as it has been mine, to remove a foreign body successfully with the bronchoscope, only to be called again to relieve the subglottal œdema by a tracheotomy, a most disheartening circumstance.

It is the opinion of the continental Europeans that per-oral endoscopy is not practical in infants and young children, up to four years of age, but that tracheotomy should be done in these cases. One has but to see Jackson at work or to read the American literature to be convinced to the contrary, that per-oral endoscopy is the procedure of election in infants and young children, provided one has developed that technique which will permit the passing of the tube through the glottis with the least amount of traumatism; and suspension aids this to the greatest degree.

I also agree most heartily with Jackson in his postulate: no anæsthesia in young children and never in infants. If there is one real contra-indication to general anæsthesia, it is in the case of a baby with insufflated foreign body which is producing some dyspnœa.

For bronchoscopy in infants and young children the head of the table is not dropped as for the regular technique, it being more convenient to have the table flat. Just sufficient extension by moving the horizontal crane outward is made to bring the posterior two-thirds of the larynx into view; there the neck is straightened by the elevation of the traveling crane and we have the posterior two-thirds of the larynx well in view, in many instances with the child's head hardly elevated from the table.

The child patient is prepared by being wrapped firmly in a sheet and the crane so adjusted that we may procure flexion of the head rather than extension, for you will remember that we are not anxious to see the anterior connissure now, but to gain sufficient room for the passage of the tube. One can use a short spatula and follow along the base of the tongue using the tube to elevate the epiglottis, though I much prefer to introduce the spatula that it picks up the laryngeal face of the epiglottis and brings into view the interior of the larynx. A solution of 5 per cent cocaine is now applied to the upper part of the larynx only, being sure that the trachea receives none of the anæsthetic fluid on account of the possibilities of diminishing the cough reflex, nature's only method of ridding its broncheal tree of excessive secretions. The surface of the larynx and vocal cords are next covered with sterile vaseline, to permit of easy passage of the tube.

With the larynx thus before you, prepared in a surgical way for the passage of a tube or any other instrument, it is an easy matter to slip the bronchoscope or œsophagoscope into its respective openings without in the least manner traumatizing the part.

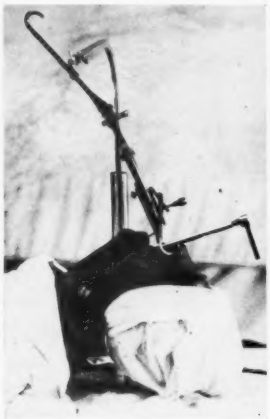
In infants and young children, one will usually inspect the parts first and in some instances remove the foreign body without other aid. I append brief reports of two cases to illustrate:

Baby, fourteen months old, undersized, underweight, somewhat pale, no dyspnœa, but typical foreign body cough. History of insufflation of watermelon seed four weeks ago. Three previous attempts were made at removal by men in the adjoining state. On suspension of the child, the seed was seen to be loose in the trachea. Elevators were slipped in between the cords to separate them, and the child made to cough, when the seed flew out of the mouth. In this instance no tube or other instrument entered below the cords. The child was so well that it returned home the same night.

A baby eleven months old had insufflated particles of peanuts. The child was suspended, and the cords separated, a mass could be seen in right bronchus. Using an ordinary head mirror with a 100-Watt nitrogen lamp for illumination, forceps were passed down the trachea and a large peanut mass removed. Several smaller pieces were seen on the tracheal wall and deep in the right bronchus. Those on the tracheal wall were removed with the suction tube and that deep in the bronchus in the same manner but through a bronchoscope.

These will serve to indicate that suspension has rather a special field of its own in foreign bodies in infants and young children and that it would precede the use of the tubes which again is in the natural order of application.

The selection and passage of the bronchoscope is the next step. One has his special likes in the matter of bronchoscopes, my preference being for the Killian baby set, which to me has these advantages: They are equipped with a hollow, smooth manderin, the blunt round surface of which will produce no traumatism at all. They give the largest working lumen and can be illuminated with a Brunnings handle, a Keirstein lamp or, as I frequently find useful, with an ordinary head mirror with a strong nitrogen lamp.



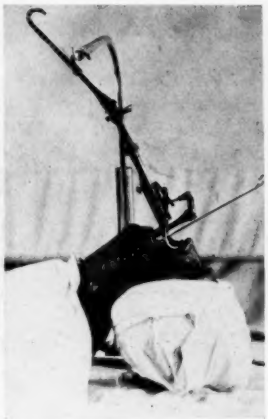


Fig. 1 (at left). New position for introducing the bronchoscope in infants and children.

Fig. 2. Introduction of bronchoscope under direct view, protecting all parts from traumatism.

Fig. 3. Bronchoscope in right bronchus showing slight difference in plane of scope and instrument.

Fig. 4. Bronchoscope in right bronchus. Applicator in œsophagus.

The tube should be well greased, as should the larynx and cords. The cords are separated by my elevator or retractor, and the tube passed into the trachea under direct vision without coming in contact with the subglottic space.

Once the tube has passed the vocal cords, the manderin is removed to establish respiration through the tube. Then we may proceed along two general plans. If it is probable that the tube will have to be removed and be reintroduced as in the case of multiple foreign bodies, it is best to retain the patient in suspension. By guiding the bronchoscope through its lumen, one will find that it is necessary to flex the head, which can be done by the horizontal movement of the crane and the worm-gear joint; one is free to move the scope laterally because of the extra width of the pear-shaped ring. It might be said that the distal end of the tube may be raised or lowered by the vertical movement of the crane. It gives one the impression of adjusting a cannon for fire; one sights through the tube to the normal lumen and path of the bronchus and by moving the traveling crane in its various directions he so aims the tube as to permit its accurate passage through the bronchus.

It might be said that with the child firmly fixed upon the suspension apparatus, it is much less likely to wriggle loose than when ordinarily held. One can handle the bronchoscope with much more delicacy by this means than ordinarily; this applies especially to the region of the stem bronchi.

In one of my peanut cases, portions of the hull of the peanut were also inspired and there were three pieces too large to come through the tube. With the suspension apparatus I had no hesitation in withdrawing the foreign body and tube because I felt no discomfort about the reintroduction. One does not relish the idea of reintroducing the tube in a baby eleven months old.

With suspension, one feels a certain sense of security about respiratory disturbances. If the tube is withdrawn, it can easily and quickly be reintroduced and if for any reason a tracheotomy should be necessary the patient is in the most ideal position for its quick performance.

If you prefer to use the tube unaided after its passage through the cords, you proceed as follows: the baby tube with manderin removed is resting in the trachea and respiration is quiet through the tube. The hook is removed from the crane and carefully tilted to the right to permit the removal of the left tooth plate; then the right tooth plate is removed in the same manner. The pear-shaped ring is bent back upon its hinge and the screw holding the spatula is now loosened and the body of the hook is in this way disengaged from the spatula. Finally the spatula is removed. One then attaches his illuminating apparatus and proceeds with bronchoscope as is usual.

The introduction of the œsophagoscope is such a simple affair under suspension that it seems needless to describe it. The mouth of the œsophagus is, in most instances, gaping and an œsoph-

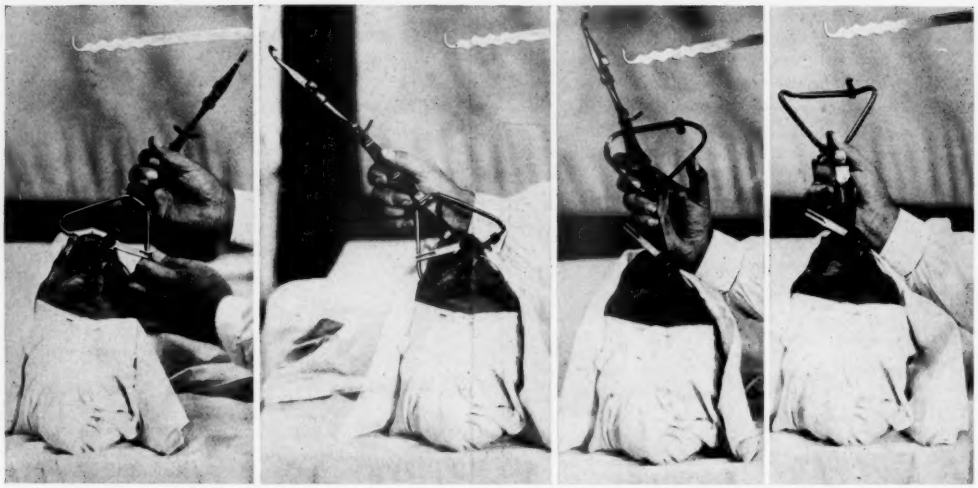


Fig. 5 (at left). Dismantling hook; latter tilted to patient's right to remove left tooth plate.
Fig. 6. Hook tilted to left to remove right tooth plate.
Fig. 7. Elevation of ring out of way of scope.
Fig. 8. Removal of spatula.

agoscope of suitable size will practically fall in. Its further passage through this canal is better managed in my opinion without the suspension apparatus, and the latter is dismantled as described above.

In the management of an impacted foreign body either in the larynx or in the mouth of the œsophagus, no instrument equals the suspension spatula. In the foreign bodies lying behind the cricoid, the cartilage may be lifted to a marked degree and space can be gained by hyperextension of the suspension spatula, that is, by tilting the tip of the spatula by movement of the worm-gear joint and by horizontal movement of the crane. By use of either the speculum for separating the cords or an elevator, one may lift the mucous membrane from an impacted point and with the other hand armed with forceps, remove, turn, twist, rotate, or fracture the offending mass and remove it without any damage whatever to the mucous membrane. Safety pins are turned, the points are bent in and the body removed easily. Teeth are cut from false teeth plates and removed and then the plates cut in two or seesawed out without tearing the mucous membrane.

Lastly with suspension the surfaces can be treated after the removal of the offending body.

For instance, in one of the watermelon-seed cases the body had produced considerable traumatism with the formation of plastic exudates in three locations. This exudate was removed, the surface was painted with tincture of benzoin, and vaseline applied to these areas as well as to the mucous membrane of the trachea. In one instance, 25 per cent nitrate of silver was applied to a traumatized spot.

I call your attention to the fact that with the aid of suspension, one is not only able to remove foreign bodies more easily and with less traumatism, but he is permitted to treat what traumatized surfaces occur and practically bandage the wound thereafter, just as our colleagues splint fractures, plaster joints, and protect abdominal incisions with gauze and adhesive.

RADICAL TREATMENT OF INTESTINAL OBSTRUCTION AND GANGRENE OF THE INTESTINE[1]

Effect of Whipple's Work on Intestinal Drainage, Methods of Mayo Robson, Moynihan, Witzel, von Mikulicz, and Maydl; Report of Two Cases

By HARLAN SHOEMAKER, A.B., M.D., Los Angeles

THE subject and method of treatment of strangulation of the intestine is open to much speculation. Every physician can cite numerous instances in which expectant treatment has cleared up the case. Occasionally this method of procedure proves a failure and the attending physician finds valuable days have slipped away; his patient is steadily growing worse, fæcal vomiting has begun, but otherwise his patient has that appearance of well being that belies the condition of the intestines which is eventually found at operation.

It is of these late cases with obstruction high up in the gastro-intestinal tract and the beginning of fæcal vomiting that I wish to speak.

In reporting the histories of two patients who recovered after I performed a radical operation for gangrene of the intestines, I also wish to call your attention to some new and old methods, and make some reference to the bearing of Whipple's work,[2] upon certain modifications in the operative technique in this class of cases.

Obstructions high in the gastro-intestinal tract, accompanied by fæcal vomiting and gangrene of the intestines, generally terminate fatally. Any method designed to save even a few of these cases may well merit some discussion.

Case 1. Von Mikulicz operation. Case history No. 91104 County Hospital. Mr. H. W. entered the hospital February 8, 1916, by ambulance. The patient's symptoms began five days before with vomiting and abdominal pain following an attack of la grippe. The lower bowel was emptied by enema but the gas in the small intestine failed to pass. The abdomen was distended and tympanitic. At the outer border of the left rectus and about opposite the umbilicus, a short wide scar was observed. It proved to be the site of a previous abdominal incision through which about 9 inches of intestine was resected. The patient was shot through the abdomen eighteen years before during a charge against the natives in the Philippine Islands. After lying on the battle field three days, he was carried to the hospital, the intestine resected and united by a Murphy button.

Operation, von Mikulicz: I opened the abdomen at the site of the old scar and within its inner border. Entrance to the abdomen was gained at the upper angle of the old incision. A small loop of jejunum was found attached to the old scar. The intestine above the adhesion was bluish, distended, and full of fluid, while below the obstruction the gut was contracted and empty. At the point of obstruction, a gangrenous band encircled the intestine and involved the mesentery. At first a lateral anastomosis was made isolating the loop after a method described by Mayo Robson. Slight pressure was used on the distended intestine to see if the fluid would fill the spastic gut. Nothing passed from the distended and paralyzed loop to the contracted and spastic loop; in fact, all the stitching at one angle of the incision gave way.

Sewing a thickened contracted intestine to a distended and stretched-out one is poor mechanics, even when the diseased part is not in the first state of dissolution. The Mayo Robson method has three disadvantages: (1.) failure of fluid to flow into spastic gut; (2) failure of stitching to hold in friable intestinal coat; (3) poor mechanics in sewing a thick, contracted gut to a dilated and paralysed gut, any one of which would be the foundation of fatal termination. This method was accordingly abandoned.

The damaged intestine was pulled out of the abdomen, the incision closed down to the intestinal loop. The loop including all intestine suspicious of gangrene was removed and the ends held in the wound by silkworm-gut sutures. A straight clamp held the intestine side to side. It was necessary to tie the clamp down into the abdomen as the pressure from within tended to force the instrument above the peritoneum. The best result with the von Mikulicz operation is gained when the spur is broken off well below the peritoneum. Two rubber tubes were placed one in each end of the intestine, the proximal one for drainage, the distal one for the purpose of aiding the water intake and possibly for nourishment.

The upper portion of the intestine emptied itself promptly enough. The abdomen became scaphoid and remained so. The tube in its lumen was as useless as the one in the distal portion of the intestine. It was impossible to make the lower bowel take oil, and the spastic condition did not change immediately. It was twenty days before anything trickled through sufficiently to promote a bowel movement. At this time the lower bowel would retain any quantity of olive oil and a bowel movement could be had at will.

The jejunostomy was near the stomach. The gastric juice poured out of the proximal end of the divided intestine in highly acid condition. The outer wall of the abdominal incision was digested down to the peritoneum in an area at least 3 inches square.

The acid discharge from the fistula showed a total acidity of 14. There was no free hydrochloric acid. Liquids and undigested food passed through the fistula 10 to 20 minutes after ingestion — the time varying with the amount of liquid.

The patient's water absorption was aided by the Murphy drip method. A mild nephritis developed

[2] Intestinal obstruction, a proteose intoxication. J. Am. M. Ass. 1915, Aug. 6.

[1] Read before the Los Angeles County Medical Society, May 4, 1916.

about the third week postoperative. Otherwise the recovery was uneventful and the patient was discharged cured, with a fistula April 29, 1916. On June 23, 1916, I resected the fistula and made an end-to-end anastomosis. Fortunately the repair of the intestine removed all the adhesions of the adjacent coils. Recovery was uneventful.

CASE 2. Case History No. 91871 County Hospital. Mrs. I. G. entered the hospital February 29, 1916, by ambulance. The present condition began five days before with acute abdominal pain referred to the region of the appendix. She had been unable to have a satisfactory bowel movement, although drastic enemas had evacuated the lower bowel. Cathartics had failed to operate. During the past twenty-four hours fæcal vomiting had been increasing in frequency.

On examination of the patient her general condition was good. A leucocytosis of 12,000 and a slight rise of body temperature (99°F.) existed; otherwise the patient presented no unusual features. Inspection of the abdomen revealed a scar in the midline below the umbilicus rather wide and white and freely movable on the underlying tissues. This scar was the site of a clean appendectomy six years previously. The abdomen was not distended nor was there any great distress upon gentle palpation. There was no abdominal rigidity.

Operation, modified Maydl. The abdomen was opened at the site of the old scar, entrance to the abdominal cavity being obtained above the upper angle of the old incision. Distended and gangrenous intestine presented itself in the wound. Beneath dense adhesions, the distal contracted and empty intestine was picked up, five feet of the damaged jejunum was resected. The distal end of the intestine was placed in the side of the proximal end by a Murphy button and the proximal end was brought through a stab wound at the site of McBurney's point. A rubber tube was tied in the lumen of the gut and carried over the side of the bed into a bottle. Within a few days the strong fæcal odor disappeared from the discharge. Subsequent treatment resolved itself into a number of problems, for example: when to close the fistula; when will the Murphy button be passed; when will the bowels resume their normal function.

The recovery from such an extensive resection was very satisfactory. The patient did not vomit and suffered no gas distention.

On the sixth day postoperative, the intestine projecting beyond the skin and tied to the drainage tube separated from the body much after the manner of the separation of the umbilical cord. Consequently the rubber drainage tube within the lumen of the gut failed to drain and finally slipped out altogether. The acid jejunal contents now spilled over the abdomen. In the meantime the original incision had healed and what stitches remained were protected from the intestinal discharges. At this time the second step of this rather complicated procedure should have been taken, namely the closing of the fistula. While debating the various means of closing the fistula, the patient became so excoriated from intestinal discharges that the next few weeks were spent in trying to heal the skin and make the patient comfortable enough to sleep. The normal bowel movements occurred intermittently after the the sixth day. Olive oil introduced into the fistula from time to time facilitated things very much. Petroleum by mouth reduced the irritability of the intestines above the fistula and ameliorated the burn on the skin.

After the fourteenth day the skin irritability became worse. The Murphy button had not passed. An instrument introduced into the lumen of the bowel detected the button in the blind end of the gut.

Undoubtedly the fistula would have been closed sooner had I known how easy it would be under nitrous oxide anæsthesia. To close the fistula the protruding end of the jejunum was pulled through the abdominal wall, crushed, cauterized, and inverted as the appendiceal stump is treated, then allowed to drop back into the belly cavity. A retaining stitch held the now blind end of the gut to the peritoneum as a matter of precaution.

The intestine, after closure, leaked gas and fæces through the fistula at least on three separate occasions. However the gas was partially held in the intestinal canal. The intestine in turn distended the abdomen which hitherto was markedly scaphoid. Ten days later the Murphy button passed and the patient left the hospital a week later, May 2, 1916.

This brief description of the two cases offers several things in common. Both were obstructed high up in the gastro-intestinal tract, both were postoperative cases. On the other hand, one, the more extensively involved of the two, was a so-called clean case which became obstructed six years postoperative, while the patient who received the greatest peritoneal trauma went eighteen years. One was an emergency operation, the other an elective operation originally. Both patients had had fæcal vomiting prior to operation. Both had a slight leucocytosis. Neither patient exhibited any reaction of pulse, temperature, or respiration.

The pathology in both cases was similar and only varied in the amount of intestine involved. The intestine was distended with fluid and gas above the obstructing bands, and completely collapsed below them. An area of gangrene existed at the site of primary obstruction.

Whipple in a recent article maintains that the lethal factor in intestinal obstruction is a poison within the intestinal tube. This poison, a primary proteose, is soluble and not altered by bacterial action, heat or acid, and when re-absorbed, which according to Whipple occurs in cases of distention and paralyses of the intestine, kills the patient.

Sir Berkley Moynihan in his monograph on "Abdominal Operations" illustrates a tube for the removal of the intestinal contents above the obstruction. He states that if this is not done the patient will succumb. The danger of soiling the abdominal cavity by removing putrifying intestinal contents with the abdomen open is very great. With a drainage two-stage operation this danger is more remote.

The several methods of treating gangrene of the intestine which have been in practice since 1890 are as follows:

Mayo Robson's method may be described as a lateral anastomosis of a single loop of bowel with a tube drain at the convexity of the loop. The operation is adapted to jejunostomy where there is no necessity for removing damaged gut. As I

have suggested, sutures hold very poorly in distended and paralyzed intestine which is one factor to be considered in this operation.

The necessity of an extensive resection eliminates the use of the Mayo Robson method.

Moynihan describes his modification of Witzel's method which is done by imbedding a rubber tube in the long axis of the bowel. The peritoneum is cast over the tube which in turn is brought out of the abdominal wall. The author has previously syphoned, or milked, all the contents of the distended and paralyzed gut out through a large metal tube passed into the lumen of the gut. Any one of the following factors make this method of Moynihan unsafe in operations for gangrene of the intestines: First, the diseased intestine is not removed. Second, simultaneous drainage and handling of the intestines will of a certainty soil the abdominal cavity and possibly be followed by peritonitis. And finally a tube small enough to be sewed into the intestine, as suggested by Moynihan, may not drain the diseased intestine sufficiently to do any good, or the site of drainage may be the seat of future obstruction.

Von Mikulicz[1] described a method of forming a colostomy with both ends of the colon projecting from the wound. The colon is sutured side to side. Some time subsequent to the first operation, a clamp is introduced, one blade in the lumen of each gut and the clamp closed. Autolysis takes place within the bite of the clamp, the spur between the two ends of intestine is cut through. The fæcal stream follows this new avenue and the fistula closes by granulation.

The von Mikulicz operation was adapted by me to the first case reported with this slight modification: I applied an operative technique designed for the colon to the jejunum and I also made use of the clamp at the time of the original operation. Using the clamp between the two portions of intestine at once obviates the necessity of extensive lateral suturing, and also the possibility of involving in the bite of the clamp an adjacent coil of intestine when inserted subsequently to the original operation. Soiling of the operative field is easily prevented by the use of soft pressure clamps higher up on the bowel.

The chief objections to the von Mikulicz operation are the soiling and digestion of the wound postoperative, and the excoriation of the skin may be so extensive as to prevent recovery through loss of sleep and general irritability on the part of the patient.

The long period of granulation necessary to heal the fistula coupled with a partial or complete loss of *succus entericus* over a similar length of time, produces marked irritability in the patient. When the greater percentage of intestinal contents pass through the bowel, the change in disposition in the patient from excessive irritability to a state of geniality is very remarkable.

The operation in the second case was designed to obviate certain disagreeable features of the von Mikulicz method: long-continued drainage, excoriation of the skin, and loss of surgical control over the closing of the fistula.

[1] Berl. klin Wchnschr, 1892, Nov. 10.

METHOD

After all gangrenous and obstructed intestine has been resected, an end-to-side anastomosis of the distal fragment is made about six inches from the end of the proximal fragment. The proximal fragment is drawn through a stab wound in the abdominal wall as far away from the original incision as possible. A drainage tube 3/8 inch in diameter is tied in the gut and carried over the bed into a bottle. The original incision is closed. Fæcal contamination of the skin will not begin until about the sixth day when the portion of intestine tied to the tube above the skin will separate at a level of the skin at the stab wound. Fæces will now flow around the tube. At this time, under nitrous oxide anæsthesia, the bowel should be drawn farther through the stab wound, crushed, tied, cauterized, and the stump invaginated similar to the method used in treating the appendix. The stump will now slip back into the abdominal cavity of its own accord. It is safe to tie the stump to the peritoneum with a single stitch. If leakage occurs it will have easy egress.

The Murphy button is used because it insures a patulous anastomosis.

The operation described was original with me at the time it was done. However, I have since discovered that Maydl described a jejunostomy somewhat similar to mine in 1891.

This method is impossible in gangrene of the intestines as the proximal fragment is too much distended to draw into the grasp of a Murphy button and too friable to hold stitches. Furthermore, drainage of the upper intestine would be imperfect even if it were possible to unite a distended paralyzed gut into the side of a contracted and spastic one.

CONCLUSIONS

1. Remove all the intestine involved by extensive resection.
2. Drain the distended gut by a fistula.
3. Close the fistula as soon as possible after the drainage has lost its fæcal odor.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD JANUARY 19, 1917, WITH THE PRESIDENT, DR. CHANNING W. BARRETT, IN THE CHAIR

INTESTINAL OBSTRUCTION FOLLOWING A GILLIAM OPERATION

DR. THOMAS J. WATKINS: I desire to place on record a case in which the Gilliam operation was followed by intestinal obstruction. The operation had been done some time before obstruction occurred. The cause of the obstruction was an opening that was left between the internal ring and a loop of the ligament brought out through a stab wound in the abdomen. This opening was not larger than the circumference of a moderate sized finger, and yet about 10 inches of the small intestine herniated through it. It became twisted 180°, became necrotic, and necessitated resection.

This case is important because it illustrates the danger of leaving such an opening with the Gilliam operation. I believe it can be safely stated that nearly all operations upon the round ligaments that are done with puncture through the abdominal wound leave an opening between the internal ring and the loop of the round ligament. I have seen very few Gilliam operations performed omitting that opening.

Dr. Simpson some ten years ago called attention to this danger and modified the Gilliam operation by puncture through the internal ring, and in that way found no opening through which the intestine could herniate.

I have been also much impressed with the fact that there is too much traumatism in operations on the round ligaments by puncture of the abdominal wall. We can do just as much shortening as we want inside of the abdomen and do it just as securely, if done carefully, with a good deal less traumatism. The old argument that there is a difference in the strength of the ligament in different places seems to be more theoretical than practical.

DR. EUGENE CARY: Inasmuch as the round ligament operation has been brought up, I would like to say a few words, concerning the operation that has been done by Dr. Webster. When I was an interne I saw quite a number of round ligaments operations done, and I think I may say they were done safely and properly. I have since seen what is termed the Webster round ligament operation done again, and while the round ligament was used, there was no real comparison between the two operations. When a great many operators report failures in the work done on the round ligament by that method, it is because they do not adhere to the proper technique.

It is important in following the Webster-Baldy technique to bring the ligaments first through the bloodless area, and second, to fasten them to the posterior wall of the uterus with non-absorbable suture material, such as linen or silk, and anchor them in such a way that the circulation of the ligament itself is not cut off. These are the essentials to the success of the Webster round-ligament operation.

MARKED PLACENTAL INFARCTION

DR. WILLIAM C. DANFORTH: I want to show a specimen removed from a young woman, 25 years of age, II-para. Her first pregnancy and labor, so far as I know, were perfectly normal. She does not believe at that time that any albuminuria was found, and her blood-pressure was not taken by the physician who had her in charge. However, she gave birth to a perfectly normal child at term, which is still living and well.

She first came under my care August 10. Until November 31, her course was uneventful at which time her blood-pressure went up to 145 and then to 160, with marked albuminuria. She was then at the hospital and kept under observation for ten days. The albuminuria decreased markedly, and her blood-pressure came down to 130 under a restricted diet and rest in bed. She was under the care of a trained nurse; her blood-pressure was taken daily; the albuminuria disappeared, and her blood-pressure remained in the neighborhood of 130 for two or three weeks, after which albuminuria occurred and remained until delivery. She went into labor four days ago, being at term January 30, and was delivered of a two pound and 14-ounce baby. The placenta is the principal thing I want to show tonight. The baby was perfectly formed. The pediatrician, who took it in charge, said that there were found slight evidences of scaling, but there was nothing syphilitic. It shows the tremendous area of infarctions, but about one-third of the placenta is active, and the remainder a large mass of infarctions, there being a sulcus where the scared area is completely separated from the live area. The entire mass at this site showed normal placental tissue.

This is my first experience with such a case. I have seen a number of infarcted placentas, more than ordinarily, with albuminuria, but never had one where the great majority of the placenta was put completely out of function with the patient going on so nearly to term. The small weight of the baby was due to the deficient blood-supply. The uterus at the time of delivery reached about to the umbilicus, where it remained for months without any evidence of growth. The child was delivered alive, but there was some trouble in getting it to breathe. It did very well for the first twelve hours, but died in eighteen hours.

DR. CULBERTSON: Did she have toxæmia or albuminuria?

DR. DANFORTH: She had a blood-pressure running up to 160, with some headache, a little epigastric pain at one time, but she did have hypertension which lasted for days, but which decreased under rest in bed and a limited diet, but recurred again. I induced labor, in spite of the smallness of the child *in utero*, at the time she went into labor.

DR. CULBERTSON: There was no œdma?

DR. DANFORTH: No.

DR. CAREY CULBERTSON: I think this case of Dr. Danforth's is interesting and suggests a point brought out in 1914 by James Young, of London, in an article which appeared in the *Transactions of the British Royal Society of Medicine*. This was illustrated with a few plates in color showing placental infarction. The point made by Young was that infarction is even more frequent than supposed and in every case of toxæmia one would find it. He seems to think that the source of poisoning in toxæmia of pregnancy is due to placental infarction. There was a series of cases reported, every effort being made to bear out that contention, that the toxæmia was associated with or due to placental infarction. In his cases of toxæmia, where the placenta was examined carefully, infarcts could be found. These infarcts did not always appear on either the placental or fœtal surface, but often in the center of a cotyledon so that the placenta would have to be sliced in order to find the infarct.

DR. CHARLES E. PADDOCK: Recently I attended a case of labor which presented an unusual feature and was of great interest to me. I presume some of you have seen similar cases but this was my first experience. A primipara with normal pelvis and head engaged went into labor at term. After three hours of characteristic first stage labor pains the membranes ruptured and soon the patient commenced to have hard, frequent, bearing down second stage pains. A rectal examination showed the head well down in the pelvis, practically upon the perineum, and occiput rotated anteriorly. No cervix evident and probably external os fully dilated.

After 4 hours of second stage labor pains and no progress, a vaginal examination was made which seemed to confirm the rectal examination. However, upon passing the finger high round the head it showed that the cervical portion was between the finger and the head and as thin as paper. The external os could not be found, the cervix being like a thin membrane over the head. With this tissue in view a search was made for the external os, which with the greatest difficulty was found although its location was immediately in view. After several failures to locate it, a small probe passed between this membrane and the head; with this probe the os was dilated without any trouble to admit a finger, and in less time than it takes to tell it the os dilated several centimeters. The case was now left to nature to deliver normally.

I am at a loss to account for the condition. There was no spasm of the cervix, in fact it was just to the contrary. What would have soon happened had the condition not been corrected would have been a complete amputation of the cervix—cases of amputation of the cervix having been reported. The necessity of vaginal examination must not be overlooked, although rectal examination in labor has limited this necessity.

RUPTURE OF THE UTERUS FOLLOWING THE USE OF PITUITRIN

DR. WALLACE F. GROSVENOR: I would like to mention a case I saw two weeks ago with another physician. Rupture of the uterus followed the use of pituitrin, the case being one of occipitoposterior position, with the head firmly entered in the foramen, but not descended to the second stage. The nurse was called at 2 o'clock, the doctor got there at 5, and at 6 o'clock, with a moderately well dilated cervix, but not a retracted cervix, four drops of pituitrin were given hypodermically. At 6:35, the head not having descended through the brim, the doctor was getting ready to apply forceps, and from five and one-half drops of pituitrin were given at about 6:35. I might say the woman was a primipara, healthy, and 20 years of age. In the second pain, after the second hypodermic of pituitrin, the woman went into collapse, and the doctor asked me to come right over. There was a rupture of the uterus; the child's body was perfectly mobile in the abdomen, and the patient was in collapse. With the consent of the priest we opened the abdomen, drew out the child and brought the uterus forward, and put a catheter around it, but the baby was dead, and the mother died within two or three minutes more. The rupture of the uterus extended from the top of the fundus on the left side just posterior to the utero-ovarian ligament, went clear down the uterus through the cervix into the vagina and up the left broad ligament to the brim of the pelvis.

DR. W. A. NEWMAN DORLAND: In connection with this case I recall that there was recently reported an abstract of a paper from Buenos Aires in which the author describes five or six cases of rupture of the uterus following the use of pituitrin in the hands of midwives. It is interesting as showing the possible danger of the use of this drug where there is obstruction or imperfect dilatation.

FULL-TERM ABDOMINAL PREGNANCY

DR. EMIL G. BECK (by invitation) read a paper entitled "Full-Term Abdominal Pregnancy; A Normal Labor Intervening Between Gestation and Operation; Specimen and Patient."

DESICCATED PLACENTA IN OBSTETRICS WITH SPECIAL REFERENCE TO VOMITING

DR. EUGENE CARY (by invitation) read a paper entitled "Preliminary Report of the Use of Desiccated Placenta in Obstetrics with special Reference to the Vomiting of Pregnancy" (see p. 206).

DISCUSSION

DR. CAREY CULBERTSON: At this time considering the immense amount of study that has been given to the internal secretions it is almost impossible to discuss pregnancy toxæmia apart from a consideration also of the internal secretions or their disarrangement.

As far as toxæmia, or the nausea and vomiting of pregnancy go, there is nothing in the literature that is at all definite. There are, however, certain fairly well formulated ideas that may be expressed with respect to the use of placental extracts. We know that as far as cellular activity goes, the placenta is only active during the stage of trophoblastic development. If we have any hormone or secretion formed in the placental tissue, it would seem to be in the stage of trophoblastic activity. If the trophoblastic stage has passed into one of degeneration, we have no structure in the placenta capable of giving out any material that would have a specific action. If the placental extract is going to be used, it should be of early placenta, or early chorionic villi before the placenta is formed as an organ. In woman this would be before the end of the fourth month. It seems to me, here is where this method of trying placental extract and treating various conditions pertaining to pregnancy fails not only in lactation but in nausea and vomiting.

I received some of this placental material from Parke, Davis & Company sometime ago with the idea of feeding it to patients to increase lactation and found it absolutely disappointing. I did not have a single case where I thought the lactation was benefited in any way. I first made effort to ascertain the time of pregnancy when placentas were taken from which to make this desiccated extract. After some delay I ascertained that they took the placenta throughout the various stages of pregnancy, some from very early pregnancies and some from full-term pregnancies, which is enough to show why this material would be inactive at certain times, and relatively inactive at all times.

So far as the treatment of the nausea and vomiting of pregnancy goes, we have the report of a very interesting series of cases given in a recent issue of the *Journal of the American Medical Association*. In this article the author, Hirst, reports 36 cases, in 32 of which the results were favorable, treated by intramuscular injections of the liquid corpus luteum. Hirst bases his treatment on the theory that, the ovary being inactive during early pregnancy, there is a relative ovarian deficiency and corpus luteum will make up for this. I have used this preparation now in five cases of the ordinary nausea and vomiting of pregnancy, but not in toxæmia, with favorable results. It should be stated that I kept the patients under the usual dietary treatment as well, at the same time.

There is another thing that is of importance in this discussion and must not be lost sight of. Hermann, Halban, and other investigators have shown experimentally that the physiologic action of the trophoblast is identical with that of the corpus luteum of pregnancy. If this is true, and if corpus luteum of pregnancy is effective, then the extract of a fresh early chorion should give the same results, or even better than corpus luteum itself, because there is more of it, and it is possible to make a stronger preparation. It seems to me, that this is just about where we stand in this matter regarding the production of an internal secretion from placenta. It is unfortunate, as has been pointed out long ago, that hormones do not produce antibodies and cannot be proved by any complement fixation tests. That is one reason why the whole matter is so difficult to work out. Another fact is that the other glands of internal secretion also are all modified in pregnancy in some degree.

DR. CARY (closing): There are only one or two points I would like to mention in closing, and one is that naturally the results that Dr. Culbertson reports would necessitate care being taken in the administration of placental extract because, we may until the dosage is established, have to confine ourselves within a safe limit, so I have made it a point to administer recently the extract in five grain doses by mouth 3 times daily for a matter of two or three days. At this time the administration was stopped because I have clinically proven that a dose of this size given for this length of time has no bad effects on the fœtus. I expected some one would take exception to the administration as given by the mouth, and as having no effect, as with thyroid extract given by mouth. The placenta contains amino-acids which are absorbed from the intestines unchanged.

FŒTAL MATURITY IN UTERO

DR. CHARLES B. REED read a paper entitled "A Study of Fœtal Maturity in Utero" (see p. 201).

DISCUSSION

DR. C. G. GRULEE: The thing that occurred to me during the reading of Dr. Reed's paper was, What definite knowledge have we that a child is mature? How do we know that a child is mature? I know we have various ideas on the subject, such as measurements, and so forth, but these measurements have been taken on children who were born

under natural conditions, and if we consider that a certain number of these cases have remained *in utero* two or three weeks longer than the time of supposed maturity, then we certainly do away with the strength of any conclusions we may draw as to what definite maturity means.

I have been struck with one fact during the last two years: I have been rather regular in my attendance on the new-born infants in the Maternity Ward of the Presbyterian Hospital, and I have been much surprised to find what a large percentage of babies will show a wide open sagittal suture. The sagittal suture itself does not seem to depend upon the maturity or prematurity of the infant. Again, we will have infants apparently born at term where the sagittal suture will be quite soft. It seems to me, the crux of the whole situation lies in what we mean by maturity and whether we have definite means of determining such a maturity.

DR. RUDOLPH W. HOLMES: If Dr. Reed had discussed in his paper these various methods of determining the size of the baby, I would be tempted strongly to corroborate what he had to say; but when he points out these various methods of determining maturity or immaturity of the baby, I think he is wide of the mark. I think Perry depended upon the size of the baby in relation to the pelvis and the adaptability of the fœtal head to the pelvis. Ahfeld had the same thing in mind, but when it comes to say a certain length means maturity or immaturity, we know there is a variation. A baby may be fully mature, and yet there are normal variations in length and weight and in the lustiness and general vigor of the body. I have used the Perry method for years. I think it is of some relative value, not only in determining the size of the baby but its maturity. When you can palpate and map out the size of the pelvis, Perry's method is a valuable adjunct in determining the adaptability of that head to the pelvis. We have to concede that 14 and even 18 pound babies do exist at term, though I have never seen one that weighed more than 13 pounds and a half. It is not in the last days, that the baby waxes strong and becomes large. It is a gradual progression from the beginning of pregnancy to the end; therefore, a baby which is going to weigh 12 or 14 pounds at 7 months will be larger than the ordinary baby at full term. Therefore, McDonald, Perry, and Ahfeld give us erroneous deductions.

DR. CHARLES S. BACON: In the consideration of this subject, I think it is well to call attention to some other factors besides the length of gestation that influence the size of the child, the length of the child, and the size of the fœtal head. One cannot say just what is the normal duration of pregnancy in any particular woman. When a woman has a period of gestation less than 280 days, in one or more pregnancies, she is apt to have the same period in subsequent pregnancies. If a woman is delivered in 268 days in one or two pregnancies, I take that into consideration in estimating the date of labor. The usual duration of gestation is an important element in determining the maturity of children.

I quite agree with what Drs. Holmes and Grulee have said that these various methods of determining the size of the fœtal head and size of the child are important, especially in cases of contracted pelves, but do they determine the maturity of the child?

In considering the obstetrical problem one method that Dr. Reed has not adopted in his studies of maturity is the impression of Mueller which, when carried out, is rather more difficult than those he has mentioned, but which is undeniably of a good deal of importance. The amount of moldability of the head, which is due in part to the factor that Dr. Grulee has spoken of, the size of the fontanelles and the distance between the bones and sutures is also an important factor in the labor. That is something that can be determined with great difficulty or perhaps not at all by any of these methods, so that while these methods are desirable, and these measurements should be made as a matter of routine in order to acquire the technique in determining the accuracy of the measurements, yet I do not believe they are of very great value in the problem which has been put before us tonight. When we take the figures which come from the Munich clinic, where the weight of the baby is taken as the chief index, we find that 7 per cent perhaps of all the children are larger than the limiting weight of 4000 grams. A study of those cases shows definitely that in the average pelvis at least, the size has not any particular bearing upon the obstetrical problem. Almost all of the labors terminated spontaneously.

The mortality of the children was rather below than above the mortality of children generally. The size of the child had very little bearing upon the general obstetrical problem, and the Munich figures would contradict the statement of Dr. Reed that a child of 10 pounds is a disgrace to the obstetrician.

DR. N. SPROAT HEANEY: The discussion so far has dealt with the point as to whether it can ever be said that a patient is due or not, since we cannot estimate the date of conception. While this is theoretically true, there is no one here present tonight who hesitates, while making rounds in a Maternity, in pointing out certain babies as mature or premature after they have been born, using largely size and weight to help him in his estimation. I am, therefore, surprised at the modesty of those who profess not to be able to tell with reasonable certainty before labor begins.

If Dr. Reed had not designated his procedures "a means of estimation of maturity," but instead had said "means of estimation of the size of the child," I think that no one here could help but concede that his work is of great value; and after all, when one estimates size and weight, he is estimating maturity by the best means that we have at our disposal.

My experience has not been so great as that of

Dr. Reed's, as I have not checked over my measurements during pregnancy with those of the child after delivery, but I have always felt that the measurements mentioned by him are of the greatest importance. I was surprised, however, to find with what accuracy his estimation and the actual size of the fœtus agree, especially in reference to the precision of measuring the fronto-occipital diameter; since the measurement before labor is of an unmolded skull while the measurements after labor are from the head which has undergone molding and especially a shortening of the fronto-occipital diameter. If there were a constant ratio existing between the measurements taken before and after labor, I would not be surprised; but to find that they are the same in such a high percentage of cases certainly requires explanation, not only because of the molding, but because of the impossibility to always accurately locate the fronto-occipital diameter. I wish Dr. Reed might tell us concerning this particular estimation. I consider myself indebted to Dr. Reed for the laborious work which he has performed in order to give us this accurate comparison between the measurements before and after labor. When these measurements can be so accurately estimated that we can tell the approximate length of the child as well as the diameters of the skull, there is little chance of inducing labor and securing a premature child if these measurements are made beforehand. Since we are looking for a safe basis, the value of this work cannot be overestimated; therefore it seems foolish to lose sight of the particular merit of this work in a discussion of theoretical conditions that prevent one from saying that any child unborn or born is definitely "mature."

DR. REED (closing): I am much gratified at the discussion that has been brought out by this little work of mine, which though tentative is a serious effort to find out exactly what is going on in the uterus, as far as we may, in the course of the last weeks of gestation.

As to what constitues maturity, of course we are in doubt. I think we can safely say that a mature child should possess those qualities of growth, development, and vigor which would enable it to live easily after birth. We could not express it any more closely than that. But what does maturity mean anyhow? Can we state decisively what those conditions are that determine maturity either in the uterus or after puberty? I think one is as safe and as certain as the other.

Dr. Bacon referred to the normal duration of labor. That, too, is a question which is moot. Without urging it as a scientific argument at all, I may say that Christ, who was the most perfect man that ever lived, probably — we may assume it at any rate — was born 275 days from the date of the Annunciation. I do not regard that as scientific, but I bring it forward as an interesting corollary to the conditions. Dr. Bacon has specifically defined prematurity in a recent publication and to do that one must have at least a vague comprehension of what constitutes maturity and therefore an idea as to the normal duration of pregnancy within certain limits.

As to the use of the Mueller method, we have used it very frequently where the pelvis is contracted, and that particular method is valuable in determining whether the head will fit a particular pelvis, but it has no reference whatever to the problem which we are trying to solve by making these measurements upon the head and body of the child *in utero*.

Dr. Heaney's remarks about the molding of the head were very pertinent, and I will say it caused us a great deal of concern to know how that problem would work out. We made a number of experiments upon the head after molding had apparently disappeared, but strangely enough we found no variation in the biparietal diameter. We found the biparietal diameter did not vary from the measurements made immediately after labor. This was an interesting fact in connection with our work, because it would seem, as Dr. Heaney remarked, as if the molding of the head as it is forcibly driven through the pelvis, must of necessity produce some changes in the biparietal diameter which we could not estimate, and that they would be restored at a subsequent date; but it is not so, the conditions are as he stated them.

The work has been extremely enlightening to me. I do not expect that there are many who would care to take the time and trouble to carry out such refinements of technique nor would they be especially concerned to ascertain how large the child is, or whether it is of any size at all. But to those who are interested in the scientific pursuit of obstetrics the problem has a definite fascination.